TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED).

VOL. LI.

[WITH TWENTY PLATES, AND ONE HUNDRED AND FIFTEEN FIGURES IN THE TEXT.]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.
ASSISTED BY ARTHUR M. LEA, F.E.S.

[The Editor of the Transactions is directed to make it known to the Public that the Authors alone are responsible for the facts and opinions contained in their respective Papers.]

PRICE, TWENTY-SIX SHILLINGS.

Adelaide:

PUBLISHED BY THE SOCIETY, ROYAL SOCIETY ROOMS, NORTH TERRACE,
DECEMBER 23, 1927.

PRINTED BY GILLINGHAM & CO. LIMITED, 106 AND 108, CURRIE STREET,
ADELAIDE, SOUTH AUSTRALIA.

Parcels for transmission to the Royal Society of South Australia from the United States of America can be forwarded through the Smithsonian Institution, Washington, D.C.

TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED).

VOL. LI.

[WITH TWENTY PLATES, AND ONE HUNDRED AND FIFTEEN FIGURES IN THE TEXT.]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.
ASSISTED BY ARTHUR M. LEA, F.E.S.

[The Editor of the Transactions is directed to make it known to the Public that the Authors alone are responsible for the facts and opinions contained in their respective Papers.]

PRICE, TWENTY-SIX SHILLINGS.

Adelaide:

PUBLISHED BY THE SOCIETY, ROYAL SOCIETY ROOMS, NORTH TERRACE,
DECEMBER 23, 1927.

PRINTED BY GILLINGHAM & CO. LIMITED, 106 AND 108, CURRIE STREET,
ADELAIDE, SOUTH AUSTRALIA.

Parcels for transmission to the Royal Society of South Australia from the United States of America can be forwarded through the Smithsonian Institution, Washington, D.C.

ROYAL SOCIETY OF SOUTH AUSTRALIA

(INCORPORATED).

Patron:

HIS EXCELLENCY LIEUT.-GENERAL SIR G. T. M. BRIDGES, K.C.B., K.C.M.G., D.S.O.

OFFICERS FOR 1927-28.

President:

PROF. J. B. CLELAND, M.D.

Vice-Presidents:

EDGAR R. WAITE, F.L.S., C.M.Z.S.

L. KEITH WARD, D.Sc.

Hon. Editor:

PROF. WALTER HOWCHIN, F.G.S.

Hon. Treasurer:

B. S. ROACH.

Hon. Secretary:

R. H. PULLEINE, M.B., Ch.M.

Members of Council:

ARTHUR M. LEA, F.E.S.

SIR JOSEPH C. VERCO, M.D., F.R.C.S.

PROF. T. HARVEY JOHNSTON, M.A., D.Sc., Representative Governor.

J .M. BLACK.

C. FENNER, D.Sc.

PROF. J. A. PRESCOTT, M.Sc., A.I.C.

Hon. Auditors:

W. C. HACKETT.

H. WHITBREAD.

CONTENTS.

Transactions

of

The Royal Society of South Australia (Incorporated)

VOL. LI.

CONTRIBUTIONS TO THE ORCHIDOLOGY OF AUSTRALIA.

By R. S. Rogers, M.A., M.D., F.L.S.

[Read November 11, 1926.]

Sarcochilus (§ Eu-Sarcochilus) spathulatus, Rogers, n. sp. Species epiphytica. Radices elongatae, filiformes, flexuosae, glabrae. Caulis brevis, circiter 1·5 cm. longus, omnino vaginis persistentibus truncatis foliorum obtecto. Folia 4 vel 5, erecto-patentia, falcata vel elliptico-falcata, circa 4-5 cm. longa, 1·0-1·3 cm. lata, ad basin sensim attenuata, acuta. Inflorescentia racemosa, pluriflora. Flores parviusculi, odorati, in diametro circa 1·3 cm., perianthio subviridi-brunneo, labello albido cum notationibus purpureis. Sepalum dorsale erectum vel subretroflexum, oblongo-ellipticum, obtusum, subconcavum, 3-nervium, circiter 6 mm. longum, 2·75 mm. latum; sepala lateralia obtuse falco-oblonga, concava, sub labello porrecta, libera, basibus antico dimidio pedis columnae adnata, 3-nervia, circiter 7 mm. longa. Petala retroflexa vel patentia, obtuse falcata, 3-nervia, sepalo dorsali subaequalia. Labellum mobile, unguiculatum, apice pedis columnae adnatum, sepalis lateralibus subaequale, 3-lobatum; lobi laterales erecti, spathulati, circiter 4 mm. longi, lobum intermedium et antheram multo superantes, apicibus abrupte dilatati; lobus intermedius brevis, pulvinatus, dente incurvo instructus, antica notationibus purpureis conspicuis ornatus; *protuberantia* plana, carnosa, late oblonga, obtusa, cava. Columna brevissima; clinandrium amplum. Anthera opercularis, abrupte rostrata. Pollinia 4, didyma. Ovarium cum pedicello gracile circa 6 mm. longum.

A small epiphyte. Roots elongated, filiform, flexuose, glabrous. Stems short, in my specimen about 1·5 cm. long, entirely covered with dry persistent truncate bases of leaves. Leaves erecto-patent, falcate or elliptic-falcate, acute, about 4-5 cm. long, 1·0-1·3 cm. wide, gradually narrowing towards the base. Inflorescence racemose, several-flowered, pedicel with ovary about 6 mm. long, slender. Flowers small, about 1·3 cm. in diameter, with greenish-brown perianth and cream labellum with purple markings, scented. Dorsal sepal erect or slightly retracted, oblong-elliptical, blunt, slightly concave, 3-nerved, about 6 mm. long, 2·75 mm. wide; lateral sepals bluntly falco-oblong, concave, porrect below the labellum, free, obliquely adnate to the distal half of the foot of the column, 3-nerved, about 7 mm. long. Petals retroflexed or spreading, bluntly falcate, 3-nerved, about as long as the dorsal sepal. Labellum attached by a short movable claw to the tip of the slender column-foot, about as long as the lateral sepals. 3-lobed; lateral lobes large, erect, narrowly oblong or linear-spathulate, about 4 mm. long, much longer than the middle lobe and greatly exceeding the anther in height, abruptly dilated at the apices; middle lobe short, cushion-like with an

inturned tooth, its anterior margin convex conspicuously purple and pubescent with 2 purple vertical tooth-like markings immediately below it; the *protuberance* flat, blunt, oblong, hollow. Column very short, not reaching above the middle of the lateral lobes of the labellum, its foot slender and greatly elongated; clinandrium capacious. Pollinia 4, attached to the gland by a common rather long broad caudicle splitting at the polliniar end into two short elastic divisions.

Queensland. Tambourine Mountains, Miss H. Geissmann; epiphytic on shrubs in company with *S. olivaceus,* Lindl.; 8th Oct., 1925.

New South Wales. Barrington Tops, Rev. H. M. Rupp; October, 1925.

Miss Geissmann, to whom botanists are indebted for many rare plants from her native mountain, has the honour of having first discovered this charming little plant. Mr. Rupp discovered it independently in N.S. Wales a week or two later.

It approaches *S. olivaceus,* Lindl., very closely, but differs in the relative length of the lateral sepals to the labellum and in the site of their attachment to the column-foot. The shape of the lateral lobes of the lip and the purple markings on the face of the latter are also characteristic. The specific name has reference to the spathulate lateral lobes of the labellum.

Bulbophyllum Elisae, F. v. M., in Fragm. vi., 120. This species has very characteristic pseudobulbs, no clear description of which appears to have been published, and which are difficult to recognise even in Fitzgerald's otherwise excellent illustrations. Though hardly crowded, they are rather closely approximated on a shortly creeping rhizome, about 1·5-1·75 cm. high, and 1·1-1·3 cm. wide, more or less ovoid in shape, and beset with shortly pointed tubercles arranged in about 7 somewhat irregular vertical rows with furrows between them. This appearance is natural to the mature pseudobulb, and is not due to "wrinkling" following its decline. The single apical leaf is smooth, rather rigid, blunt, moderately thick, frequently flat, oblong or oblong-elliptical, from about 5-7 cm. long, and 1·0-1·25 cm. wide.

The inverted flowers are usually, but not invariably secund, green in colour but acquiring a yellowish tint with age and may be at once distinguished by the great disproportion in length between the dorsal and lateral sepals (1:4 in my specimens). The diminutive petals are completely concealed by the sepals. The short, fleshy, reddish-brown, tongue-shaped labellum forms a marked contrast to the prevailing colour of the perianth-segments. There is no evidence of any tendency to "twisting" of the lateral sepals, such as occurs in *Cirrhopetalum,* Lindl.

The column is produced upwards at the back of the clinandrium into a tooth, to which the anther is lightly affixed, and on each side in front the column-wings terminate above in a short truncate tooth. The stigma lies at the back of a large deep cavity below the floor of the clinandrium. Pollinia 4, unequal, in 2 pairs.

If this plant is to be retained in *Bulbophyllum,* Thou., taxonomic difficulties will arise, and a special section will probably have to be created for it. On the other hand, Bentham appears to think that it should be excluded from *Cirrhopetalum,* Lindl., owing to the absence of some of the essential characters of that genus.

Some plants received by me from Miss Geissmann, Queensland, bloomed on some *débris* from a wood-heap in Adelaide, with unexpected ease, and without care or attention. The identity of the pseudobulbs was thus definitely established. Fitzgerald states that he has found it growing on "fig trees" in the Blue Mountains.

Queensland. Tambourine Mountains, Miss H. Geissmann.

New South Wales. Dunn's Creek, near Paterson, Rev. H. M. Rupp.

Gastrodia sesamoides, R. Br. As was anticipated, this plant has at last been discovered in South Australia. It has also reached me from New Zealand, and every State in Australia, except the Northern Territory. It has

therefore a very extensive geographical range. So far as is known, it is the sole representative of the genus in the Commonwealth, having covered this vast area without modification.[1] A second species, *G. Cunninghamii*, Hook f., has also been recorded from New Zealand.

Like other members of the genus, our species is leafless and saprophytic.

Its mode of fertilization does not appear to have received consideration, although in the case of an orchid so widely distributed and so suggestive in structure, this problem should not present insuperable difficulties in a locality where it is common.

The inconspicuous flowers are arranged on short pedicels in a loose raceme. They are brownish-yellow in colour with whitish tips and bell-shaped in form, owing to the union of the perianth segments. In some living material before me, the uppermost flowers on the inflorescence are usually erect, the others nodding with the labellum above (inverted). The lateral sepals are united for a little more that half their length and are gibbous at the base; the other segments are more completely united, but their blunt apices are free. Thus a V-shaped space is left between the free portions of the lateral sepals, affording easy access between the labellum and column, the apices of which are exactly the same height. When the flower is erect the labellum falls a little away from the anther; when the flower *nods,* it rests ever so lightly against the latter, and in such a way that it may be easily raised by an insect attempting to enter the bell. It would also have the effect of causing such a visitor to brush against the granular pollen extruded between the front of the anther-cap and the smooth anterior margin of the column summit. In the erect position, any pollen escaping from the anther must fall downwards on the stigma, which is situated on a sloping surface at the extreme base of the elongated column. The stigmatic surface is very moist and this exudate may be attractive to insects. As the column is 1 cm. in length, the distance between pollinia and stigma is very considerable. The anterior margin of the column top is horizontal, reflexed against itself, and is not at all viscid. It does not therefore serve the function of a rostellum. The column itself is flat and erect but quite hollow throughout its length, being traversed by a wide stigmatic canal. It is dilated at the summit in both diameters, so as to form a sort of cup, which receives the anther. It is produced into a blunt tooth at the back of the anther, and into a similar tooth on each side of the latter in front. The anther which is lid-like and hemispherical sits on the summit between these three teeth, and only appears to be attached by a little mucus to the posterior one. It is capable of easy removal. It is bilocular, each cell being incompletely subdivided by a short septum from its vault. The pollinia are very granular and remarkably like those of the genus *Prasophyllum.* There are 4 masses, united by a little mucus by their apices just above the anterior margin of the column summit. Their under surfaces are freely exposed over the pseudo-clinandrium, which in turn communicates freely with the wide stigmatic canal. There is no caudicle or definite disc. The pollinia may be extracted *en masse* with little difficulty, especially if the tip of the needle be first brought into contact with the stigmatic exudate.

The labellum is white and movable on a wide claw, which is adnate to the gibbosity at the base of the sepals. Including the claw, it is 1 cm. long, straight, erect against the column, ovate-oblong in outline or obscurely 3-lobed, apex truncate; margins upraised, lacerated or fringed; lamina with a conspicuous raised yellow central guide-line from apex to the middle of the lamina, where it bifurcates as far as the base; at the base and on the claw there are two large undulate or sigmoid yellow callosities.

---

(1) Bailey described from Queensland a species *G. ovata,* but this is now known to belong to the genus *Cheirostylis,* Bl.

The plant is evidently capable of cross-pollination, but like *Prasophyllum gracile*, Rogers, it may have other means of effecting this purpose.

South Australia. Flinders' Chase, Kangaroo Island; Prof. F. Wood Jones, October 31, 1924.

The genus itself, extends northwards to India, Malay Archipelago, New Guinea, Celebes, Philippines, China, and Japan.

Calochilus imberbis, Rogers, n. sp. Species terrestris, subrobusta, habitu *C. Robertsonii*, Benth., circiter 20-37 cm. alta. Caulis glaber, prope medium bractea elongata subulata. Folium subrigidum, carnosum, canaliculatum, exteriore carinatum, lineari-lanceolatum, ad basin inflorescentiae vulgo attingens. Inflorescentia racemosa. Flores 3 vel 4, virides vel subvirides, longe pedicellati, bracteis 1·3-4·0 cm. longis. Sepalum dorsale erectum, ovatum, acutum, cucullatum, pluri-nervium, circiter 1·6 cm. longum, 1·0 cm. latum; sepala lateralia libera, sub labello patentia, divaricata, circiter 1·5 cm. longa, 6 mm. lata, pluri-nervia. Petala late triangularia, falcata, erecta, obtuse uncinata, concava, nervis purpureis parallelis conspicuis ornata, circiter 7 mm. longa, 4 mm. lata. Labellum petaloideum, sessile, planum, ovatum, acutum, patens, marginibus integris, concavum, nervis purpureis conspicuis ornatum, circiter 1·1 cm. longum, 6 mm. latum, callis nullis. Columna brevis, post basin antherae producta, antice alis lamina conspicua scutiforme alta conjunctis, utrimque glandula purpurea. Anthera obtusa, breviuscula.

A rather stout species with the habit of *C. Robertsonii*, Benth. About 20-37 cm. high. Stem with a long loose subulate bract near the middle. Leaf somewhat rigid, fleshy, channelled, keeled on the outside, linear-lanceolate, reaching to about the base of the inflorescence. Inflorescence racemose; with 3 or 4 green or greenish flowers, on rather long slender pedicels, subtended by a floral bract 1·3-4·0 cm. long. Dorsal sepal erect, ovate, acute, hooded, plurinerved, about 16 mm. long, 10 mm. wide; lateral sepals free, ovate, acute, concave, spreading below the labellum, divaricate, about 15 mm. long, 6 mm. wide, plurinerved. Petals widely triangular-falcate, erect, uncinate, concave, traversed by conspicuous purple veins, about 7 mm. long, 4 mm. wide. Labellum petaloid, sessile, simple, ovate, acute, spreading, margins entire, with 7 conspicuous purple nerves, concave, lamina without calli hairs or other processes, about 11 mm. long, 6 mm. wide. Column short, produced behind the base of the anther; the wings connected in front by a high conspicuous shield-like plate, a purple gland at the base of each. Anther blunt and rather shorter than in *C. Robertsonii*, slighly inclined forward.

Victoria. Rushworth, Mrs. Fred. Rich, October 3, 1923; Ringwood, Mrs. Coleman, October, 1924.

This plant is well separated from other members of the genus by its beardless labellum, and by the conspicuous plate at the base of the column. The flowers, though not so regular as in the genus *Thelymitra*, Sw., show an approach to actinomorphy which is very unusual in orchids. The lip is distinctly petaloid, but the lateral petals retain the shape which is common to all known species of *Calochilus*. It apparently occurs in considerable numbers and has been found in two distant localities. Mrs. Rich reports that it was found growing in association with *C. Robertsonii*, Benth., the pelorial state of which it may prove to be the representative.

Thelymitra chasmogama, Rogers, n. sp. Species terrestris, gracilis, glabra, basi scapi vagina scariosa, 25-30 cm. alta. Folium anguste lineare, subtenue, subrigidum, canaliculatum, acutum, circiter 10-12 cm. longum, basi vaginans. Caulis carneus, subflexuosus vel fere strictus; bracteae 2, subulatae, vaginantes. Flores circiter 2, carnei, illis *T. carneae*, R. Br. similes, libere chasmogami; pedicelli graciles; ovaria subgracilia, teretia; bracteae parvae, acutae. Segmenta perianthii circiter 1·2-1·3 cm. longa, elliptica. Columna circiter 6·5 mm. longa,

cucullata; lobi laterales penicillati, lutei, illis *T. luteociliatae*, Fitzg. similes; cucullus tubiformis, marginibus integris, inter lobos laterales productus. Anthera obtusa, sub lobis penicillatis apice conspicuo; pollinarium facile deportatum.

A slender glabrous plant with a scariose scale at the base, from 25-30 cm. high. Leaf with a closely sheathing reddish cylindrical base, about 5 cm. long; its free lamina greenish-yellow, narrow-linear, about 10-12 cm. long, rather thin and rigid, acute, channelled. Stem pinkish, with tendency to angulation or nearly straight; bracts 2, subulate, closely sheathing. Flowers 2, on slender pedicels, each subtended by small acute sheathing bract, a floral rudiment at the base of the uppermost bract; ovaries rather slender, terete; pink in colour, resembling those of *T. carnea*, R. Br., opening freely at very moderate temperature (78° F.); segments of perianth about 1·2-1·3 cm. long, elliptical, the inner ones much wider than the outer. Column about 6·5 mm. long, the lateral wings carried forwards and upwards into 2 yellow penicillated processes, as in *T. luteociliata*, Fitzg.; the hood produced forwards into a yellow tube with smooth entire margins. Apex of anther prominent and blunt, showing distinctly from the side and in front below the hairtufts; anther-case carried high above the stigma, dehiscing and leaving the pollen-masses attached to the viscid disc and partly hidden by the stigma. Stigma semi-oval, viscid disc in a slot in its upper border. Pollinia attached directly to the disc without intervention of a caudicle.

South Australia. Golden Grove; Dr. and Mrs. Rogers, October 23, 1921.

This plant may be the plains representative of *T. luteociliata*, Fitzg., which is a mountain form. It differs from the latter in the shape of the hood, which is incomplete in Fitzgerald's plant. It likewise completely differs in the structure of its pollinarium, which is adapted for cross-pollination, whereas in the hills form self-pollination is accomplished very early in the bud-stage, and the flowers very rarely open, and then only for a brief interval. It is easily separated from *T. carnea*, R. Br., by the presence of penicillate lateral lobes.

In three plants, all fully expanded, which I examined, the pollinia were still *in situ*, but were easily removed on a needle. Such removal is impossible in *T. luteociliata*, Fitzg.

Thelymitra Elizabethae, F. v. M., in Vict. Nat., vii., 1890, p. 116. In his very brief and imperfect description of this plant, the Baron refers to it as "a variety of *T. carnea*, R. Br., or as a distinct species." I am of opinion that it is a valid species and should be regarded as quite distinct from *T. carnea*, R. Br. It is not included in "A Census of the Plants of Victoria," 1923, issued by the Field Nat. Club. As the column and appendages dry more or less black, the discrepancies regarding colour details, between the following description (made from living material) and that of the Baron (probably made from dried material) will be understood.

A very slender species, 12-18 cm. high. Leaf reddish at the base where it embraces the stem, terete, or linear-terete and very slightly channelled, 8-9 cm. long, usually erect. Stem very slender, usually reddish, straight or slightly flexuose, with 2 closely sheathing subulate bracts. Flower solitary, very rarely 2, very small, red *(not pink)*, on large elongated ovary; perianth segments about 7 mm. long. Column about 4 mm. long, pink, with a yellow apex; the latter 3-lobed; the middle lobe yellow, imperfectly hooded, arched, slightly denticulate, with concave anterior margin and smooth dorsum; lateral lobes yellow, oblong, blunt, smooth on outside, edges minutely dentate, about as high as the anther and a little higher than intermediate lobe. Lower margins of the column wings united in front to a much higher level than in *T. carnea*. Base (only) of the anther concealed by the stigmatic plate, the apex showing prominently between the lateral lobes. A self-pollinating species, absorption of the rostellum proceeding in flowers under examination.

Victoria. Ringwood; A. J. Tadgell, October 28, 1923.

The rediscovery by Mr. Tadgell, of this plant, which seems to have been lost sight of for many years, is interesting. It is much more slender than *T. carnea,* with a different leaf and much smaller flowers, the latter being slightly smaller than those of *T. flexuosa,* Endl.

In several specimens staminodia representing anther a_3 were present.

Microtis orbicularis, Rogers. The range of this orchid has now been considerably extended by its discovery in the Western State. Until recently it had only been found in the Myponga district. It is now known to occur also at Encounter Bay.

South Australia. Encounter Bay, November 3, 1924, J. B. Cleland.

Western Australia. Kenwick, O. Sargent, September 10, 1921; Highbury, growing in water in winter swamp, Col. B. T. Goadby, end October, 1924.

Cryptostylis subulata (Labill.), Reichb. f. Beitr. 15. Synonyms.—*Malaxis subulata,* Labill., Pl. Nov. Holl., ii., 62, t. 212; *Cryptostylis longifolia,* R. Br., Prod. 317.

Diuris fastidiosa, Rogers, n. sp. Species terrestris, humilis, gracillima, circa 5·5-20 cm. alta. Folia 7 vel 8, setacea, ad 11 cm. longa. Caulis glaber, basi vagina cylindrica scariosa; bracteae 2, infera laxa elongata subulata, supera breviore vaginante. Flores 1-3, racemosi, lutei, notationibus badiis ornati; pedicelli longi gracillimi; ovarium anguste elongatum pedicellos excedens. Sepalum dorsale subovale, erectum, subacutum, apice recurvum, basin columnae amplexans, 9-nervium, inferiore dimidio notationibus badiis ornatum, circiter 11 mm. longum, 6 mm. latum, labellum aequans; sepala lateralia subviridia, linearia, parallela, patentia, canaliculata, circiter 1·75 cm. longa, segmenta cetera multo excedentia. Petala 7-nervia conspicue stipitata, circa 1·3 cm. longa, sepalis lateralibus breviora; lamina elliptica, lutea; stipes badius, circa 4 mm. longus. Labellum verticale vel subverticale, notationibus badiis irregularibus ornatum; 3-lobatum, bene supra basin divisum; lobi laterales oblongi, obtusi, marginibus exterioribus leviter dentati, circa 6 mm. longi, dimidium labelli paululo excedentes; lobus intermedius obtuse spathulatus, inter lobos laterales in unguem abrupte attenuatus, marginibus integris, circa 11 mm. longus; unguis lobi intermedii lineis duo late separatis elevatis pubescentibus parallelis instructus. Anthera obtusiuscula, in altitudine rostellum et lacinias laterales aequans. Laciniae laterales columnae late membranaceae, apice longe subulatae, marginibus irregularibus.

A small species, very slender, from 5·5-20 cm. high. Leaves 7 or 8, setaceous, about half the height of the scape. Stem glabrous with 2 bracts, one loose elongated subulate, the other much shorter and closely sheathing, a membranous cylindrical sheath at the base. Flowers racemose, 1-3 in my specimens, on long very slender pedicels, yellow with dark-brown markings; ovary narrow elongated; bracts loose subulate exceeding the pedicels. Dorsal sepal more or less oval, erect, subacute, recurved at the apex, clasping the column at the base, 9-nerved, brown markings in the lower half, about 11 mm. long, 6 mm. wide, equalling the labellum in length; lateral sepals greenish, linear, parallel, spreading, channelled above, about 1·75 cm. long, greatly exceeding the other segments, no tendency to cross. Petals 7-nerved, markedly stipitate, about 1·3 cm. long, shorter than the lateral sepals; lamina yellow elliptical, stipes dark brown about 4 mm. long. Labellum vertical or subvertical, with irregular brown blotches or markings; 3-lobed, the division well above the base; lateral lobes oblong, blunt, slightly dentate on the outer margins, about 6 mm. long, slightly exceeding half the length of the labellum; middle lobe obtuse spathulate, narrowing posteriorly between the lateral lobes into a claw, margins entire, about 11 mm. long; lamina with 2 well separated pubescent raised parallel lines on the claw of the middle lobe, succeeded by a single keel to the apex. Anther rather blunt, equalling in height the rostellum and lateral

appendages. Lateral appendages membranous, wide with irregular borders and long subulate apex.

Victoria. Tottenham, W. H. Nicholls. Blooms August and September.

This species approaches *D. palachila,* Rogers, very closely in the flower, but is well separated by its setaceous leaves and lowly habit. Whereas the lateral sepals are about equal in length to the petals in *D. palachila,* they are considerably longer than all the other segments in the new species, and there is no tendency to cross. Mr. Nicholls states that "all the flowers point to the sky," *i.e.,* the labellum is more or less vertical. From this habit, the specific name is derived. Another closely related species with setaceous leaves, *D. setacea,* R. Br., is a native of Western Australia; but here the lateral sepals and petals are about equal in length, and the raised lines are closely contiguous; likewise the intermediate lobe of the lip is trapeziform in shape. From *D. palustris,* Lindl., another species with setaceous leaves, there is no difficulty in distinguishing the Tottenham plant, owing to the extremely short petals and large lateral lobes of the lip in Lindley's plant.

Prasophyllum validum, Rogers, n. sp. Specimina mea imperfecta. Spica validissima, ad 17 cm. longa, 28-flora. Flores in genere inter maximos, sublaxi, sessiles; bractea parva, acuta, appressa. Sepalum dorsale ovatum, acutum, incurvum erectum, in floribus senilibus recurvum, 1·3 cm. longum, 4·75 mm. latum; sepala lateralia arcuata, patentia, inferne ultra medium connata, apicibus liberis, circiter 1·35 cm. longa, 5 mm. lata (conjuncta), acuminata. Petala erecta, incurva, lineari-lanceolata, sepalis angustiora et breviora. Labellum breviter unguiculatum, in ambitu subovatum, apice subacutum, basi contractum, in dimido inferiore erectum concavum, deinde horizontale patens; pars callosa conspicue viridis, elevata, triangularis, prope apicem abrupte terminans; margines albidi, lati, in dimidio inferiore integri, deinde crenulati, flexu lateraliter contracti. Anthera badia, apiculata, apice recurva, rostello multo brevior; laciniae laterales oblongo-falcatae, erectae, lobo basilare satis magno, rostello breviores, antheram aequantes; rostellum erectum, subgracile, apice discum conspicuum gerans; caudicula moderate longa.

Specimens incomplete, stem and leaf absent. Spike very robust, upwards of 17 cm. long, with about 28 flowers. Flowers amongst the largest in the genus, green, not crowded, sessile, subtended by a small acute appressed bract. Dorsal sepal erect, ovate, acute, incurved, later recurved, about 1·3 cm. long, 4·75 mm. wide; lateral sepals spreading, arched, connate to within a short distance of the apex, about 1·35 cm. long, 5 mm. wide (conjoined), acute. Petals erect, incurved, linear-lanceolate, narrower and shorter than the sepals. Labellum shortly clawed, somewhat ovate in outline, subacute at tip, contracted at base; in the lower half erect, concave, thereafter recurved at right angles; callous part conspicuous, green, triangular from the base, elevated, ending abruptly near the apex; margins white, voluminous, entire in lower half, thereafter crenulous, laterally contracted at the bend. Anther reddish-brown, apiculate, apex retracted, much shorter than the rostellum; lateral appendages oblong-falcate, erect, with a rather large rounded basal lobe, shorter than the rostellum, about equal to the anther; rostellum erect, rather slender, with a distinct disc at its apex; caudicle moderately long. Lateral index=82.

South Australia. Melrose, Dr. J. B. Cleland, October 27, 1926.

This plant has the robust habit of *P. elatum,* R. Br., but with a very different labellum. The flower in its structure most closely approaches the prune-coloured *P. constrictum,* Rogers, a plant which I received some years ago from Tailem Bend in this State, but the flowers are very much larger, differ in colour, considerably in the column, and in several important respects also in the labellum.

Prasophyllum Hartii, Rogers, n. sp. Species validissima, ad 60 cm. alta. Folium erectum, inflorescentiam vulgo excedens. Inflorescentia laxiuscula, 15-30-flora; bracteae appressae obtusissimae. Flores majusculi, badii, subsessiles; ovarium magnum, viride, obconicum, turgidum. Sepalum dorsale erectum, apice recurvo, ovatum, acutum, concavum, circa 5-nervium, dorso glandulosum, circa 8 mm. longum, 5·25 mm. latum; sepala lateralia elliptico-falcata, acuminata libera, 10 mm. longa, 3 mm, lata, 3-nervia, intus concava, patentia, parallela. Petala erecta, elliptico-falcata, obtusiuscula, 8 mm. longa, 2·5 mm. lata. Labellum breviter unguiculatum, purpureum, ovatum, acutum, basi ample ventricosum, fere erectum, marginibus integris latissimis; in parte tertia terminali recurvum; pars callosa flexu conspicue elevata, hastata, carnosa, perglandulosa. Columna brevissima, latissima. Anthera badia, ovata, erecta, subplana, obtusiuscula, rostello brevior. Laciniae columnae latissime oblongae, erectae vel incurvae, basi bilobulatae; apices sublaceratae, truncatae, dente posteriore parvo subulato instructae, rostellum aequantes. Rostellum erectum, bifidum. Caudicula mediocris gracilis.

A very robust species, attaining a height of 60 cm. Leaf usually exceeding the inflorescence. Inflorescence not crowded, consisting of about 20-35 reddish-brown or prune-coloured flowers rather large for the genus. Flowers subsessile, subtended at the base by a short very obtuse bract. Ovary relatively large, green and turgid. Dorsal sepal erect, but recurved at the apex, ovate, acute, concave, about 5-nerved, glandular on the outside, about 8 mm. long, 5·25 mm. wide; lateral sepals elliptic-falcate, acuminate, free, 10 mm. long, 3 mm. wide, 3-nerved, concave on the upper surface, spreading, parallel. Petals erect, elliptic-falcate, rather blunt, 8 mm. long, 2·5 mm. wide. Labellum shortly and broadly clawed, prune-coloured; the basal two-thirds more or less erect, voluminous, ventricose, very concave, the margins very wide rounded and entire; thereafter recurved at right angles into a triangular acute tip with somewhat crenulate narrow margins; callous part conspicuously raised, hastate, with thickened very glandular margins, extending a little beyond the bend. Column more or less prune-coloured, very short and wide. Anther dark brown, ovate, erect, rather flat, not apiculate, distinctly shorter than the rostellum and lateral appendages. Lateral appendages very widely oblong, erect or incurved; apices truncate, notched or lacerated, with a small subulate tooth posteriorly; basal lobe rounded about half the height of anterior lobe. Rostellum erect, bifid. Caudicle slender, of medium length. Lateral index 80.

Victoria. Bairnsdale, Mr. T. S. Hart, M.A., November 9, 1925.

This prasophyllum is not likely to be confused with any other published species. Its robustness, colour of flowers, most characteristic and extremely wide labellum cause it, in my opinion, to stand apart from all other members of the genus. The contrast between the green ovary and the dark flowers is noticeable even in dried specimens.

Corysanthes undulata, Cunng. Among some orchidaceous material received in 1924 from the Rev. H. M. Rupp, of New South Wales, there was found an apparently undescribed species of the genus *Corysanthes*, R. Br.

The investigation of this plant rendered it necessary to refer to Cunningham's original description of *C. pruinosa*, which appeared in that short-lived and long forgotten publication, the *New South Wales Magazine*, No. 1, 1833, p. 41. A photostat copy, supplied by the Public Library, Sydney, unexpectedly revealed the description of another orchid, *C. undulata*, Cunng., which had evidently been overlooked by the earlier botanists, and had consequently not passed into current literature. There was little difficulty in recognising in this the description of the plant under observation.

In appending Cunningham's description of this long-lost species, I take the opportunity of also including that of *C. pruinosa*, which immediately preceded it, as the reference appears to be little known to botanists:—

"*C. pruinosa* labello ecalcarato, infra cucullato, supra dilatato, disco hirsuto, marginibus inflexis fimbriatis, galea basi attenuata erecta, apice mucronato."

"*C. undulata* labello basi bicalcarato, infra cucullato, supra dilatato, marginibus inflexis undulatis."

The species must probably be regarded as the smallest Australian member of the genus, as my specimens are hardly as large as *C. unguiculata*, R. Br.

To meet modern requirements Cunningham's brief description should be amplified as follows:—Leaf variable in size, definitely cordate, subpeltate, upper surface green, grey below, about 7-12 mm. long, 6-10 mm. wide; an intramarginal vein fed by others radiating from the insertion of the stem. Flower single, dark-purplish red except for a whitish disc on anterior surface of labellum, about 10-12 mm. high from leaf to top of galea. Dorsal sepal scaphoid, very concave, galeate, only *slightly* concealing labellum, attenuated towards the base, margins entire, quite blunt or slightly apiculate at apex, about 6-10 mm. long; lateral sepals vestigial, white, membranous, linear-lanceolate, erect between the spurs, about 3·5 mm. long. Petals minute, white, membranous, shorter than the lateral sepals, about 1·75-2·5 mm. long. Labellum voluminous, margins at the base in apposition forming an erect split tube around the column; rather sharply recurved about the middle and expanding into a trumpet-shaped orifice with minutely denticulated margins; lamina of the recurved part furnished with a large whitish glandular pubescent boss in the centre; produced on each side at the base into a short spur. Column very short, about 2·5 mm. high.

New South Wales. Bulladelah, Rev. H. M. Rupp, June 10, 1924, "growing in a scrub of *Melaleuca nodosa*, on hard damp clay." Mr. Rupp adds that the species appeared numerous, but difficult to find on account of its small size.

An examination of my specimens shows a tendency to lobulation of the leaf, so common in members of this genus.

Caleana Sullivanii, F. v. M., in Melbourne Chemist and Druggist, 1882, p. 68. Apart from the description by the author of this species, the plant remained practically unknown until it was rediscovered by Mr. C. W. D'Alton forty-two years later. As the plant appears to be of extreme rarity, it may be of interest to supplement the original description from my observation of living material recently supplied by Mr. D'Alton:—

Plant very slender, with the habit of *C. minor*, R. Br., reddish-green, entirely glabrous, about 8-10 cm. high. Leaf rusty-green, basal or nearly so, very narrow-linear, about 4 cm. long, 0·75 mm. wide. Stem erect, reddish-brown, ebracteate. Flowers inverted, usually 2 or 3, with a floral rudiment within the uppermost flower-bract; pedicels slender, about 4-5 mm. long, subtended by a short subacute and relatively wide bract; unpollinated ovary ellipsoidal, about equal in length to the pedicel. Sepals subequal, narrow linear in lower half, dilated above, about 6-7 mm. long; dorsal sepal subulate, erect or slightly incurved, subacute; lateral sepals erect, their bases entirely adnate to the column-foot, angulated, narrow-linear, subacute. Petals narrower and rather shorter than the other segments. Labellum cuneate-ovate, attached by its rather long and claw-like base to the apex of the column-foot, without the intervention of a movable joint; the margins entire; lamina more or less horizontal, about 6 mm. long (including the basal part), dome-shaped above, tapering into a bare rather blunt triangular apex, traversed along the middle of the convex surface by more or less numerous sessile purplish glandular calli arranged in 2-4 ill-defined rows; the lower surface very concave. Column subequal in height to the lateral petals; refracted almost at right angles with the ovary; very widely winged as high as the stigmatic base and

produced on each side of the latter into wide blunt membranous lobe; the apex split transversely into 2 short unwinged stipes, the longer or posterior one bearing the anther, and the anterior bearing the stigma; produced at the base into a definite, though not very long foot. Anther erect, stipitate. Stigma large, ovate, pedicellated, forming a prominent disc in front of the basal part of the anther.

Victoria. On Wonderland Range in the Grampians, C. W. D'Alton, December 19, 1924.

The above locality is within 20 miles of Mount Zero, where it was first discovered in 1882.

Mr. D'Alton found it growing very sparingly, in company with many specimens of *C. minor*, R. Br., "in mossy crevices on open rock-surfaces, facing the sun, which they evidently like."

In *C. minor*, R. Br., there is no transverse splitting of the summit of the column, which is widely winged throughout, the stigma being sessile. It is possible that this orchid may have been overlooked by collectors owing to its close superficial resemblance to *C. minor*, with which it is found associated.

Eriochilus cucullatus (Labill.), Reichb. f. Beitr. 27. Synonyms.—*Epipactis cucullata*, Labill., Pl. Nov. Holl., ii., 61, t. 211, f. 2; *Eriochilus autumnalis*, R. Br., Prod. 323.

Caladenia triangularis, Rogers, n. sp. Herba terrestris, circa 17 cm. alta. Folium oblongum, hirsutum, subacutum, circa 4·5 cm. longum, 0·7 cm. latum. Caulis subrigidus, hirsutus, prope medium bractea laxa subulata circa 1·5 cm. longa. Flos solitarius, albidus, lineis porphyreis ornatus, in diametro fere 8 cm.; bractea appressa, circa 1·0 cm. longa; pedicellus cum ovario gracilis, circa 2·7 cm. longus; segmenta perianthii similia. Sepalum dorsale erectum, in medio 3 lineis porphyreis longitudinalibus, circa 3·4 cm. longum, deorsum dilatatum, subbreviter acuminatum, apice glandulosum; sepala lateralia patentia, in medio linea porphyrea, sepalo dorsali latiora sublongioraque. Petala patentia, in medio linea porphyrea, sepalo dorsale subangustiora. Labellum unguiculatum, in ambitu triangulare, circa 1·5 cm. longum, 1·0 cm. latum, 3-lobatum; lobi laterales sublonge pectinati; lobus intermedius sublongus, plus minusve breviter dentatus; lamina basi lineis porphyreis radialibus ornata; calli lineares biseriati lutei, medium non transeuntes. Columna circa 1·0 cm. alta, incurva, plus minusve erecta, in dimidio superiore late alata; basi biglandulosa. Anthera longe mucronata.

Species terrestrial, with the habit of *C. Patersonii*, R. Br., about 17 cm. high. Leaf oblong, hairy, subacute, stem with a single loose subulate bract about 1·5 cm. near the middle. Flower solitary, cream-coloured, with reddish-brown lines, relatively large, nearly 8·0 cm. in diameter; flower-bract about 1·0 cm. long, appressed; pedicel with ovary slender, about 2·7 cm. long; segments of perianth nearly similar. Dorsal sepal erect, traversed by 3 reddish longitudinal lines, about 3·4 cm. long, dilated below, contracting gradually into a moderately short glandular point as in *C. hirta*, Lindl.; lateral sepals similar to dorsal sepal, but wider and rather longer, spreading. Petals similar, spreading, rather narrower than dorsal sepal, with one red longitudinal line. Labellum clawed, ovate-triangular in outline, about 1·5 cm. long, 1·0 cm. wide; the lateral lobes rather deeply combed; middle lobe triangular, rather long, subacute, shortly fringed or dentate; lamina with radiating red lines at the base; calli linear, orange, in 2 rows, not extending beyond the middle. Column about 1·0 cm. high, curved, more or less erect, widely winged above, more narrowly below; 2 yellow glands at the base. Anther with long point.

Western Australia. Highbury, between Wagin and Narrogin; Colonel B. T. Goadby; late September, 1924.

I am indebted for this plant to the kindness of the well-known botanist, Col. B. T. Goadby, of Western Australia. It belongs to the Section *Calonema*, but inasmuch as it has the habit of *C. Patersonii*, R. Br., the perianth segments of *C. hirta*, Lindl., and the biseriate calli of *C. filamentosa*, R. Br., it is rather difficult to arrange in orderly sequence. I think for the present it had better precede *C. hirta*, Lindl. It is readily distinguished by its habit and short segmental points from *C. filamentosa*, R. Br., on the one hand, and on the other from *C. Patersonii*, R. Br., and *C. hirta*, Lindl., by its calli.

Caladenia lavandulacea, Rogers, n. sp. Species terrestris, gracillima, circa 22·5 cm. alta. Folium anguste lineare, hirsutum, canaliculatum, circa 11 cm. longum. Caulis badius, gracillimus, hirsutus, supra medium bractea subulata gracilis. Flos solitarius, lavandulaceus, fere 5 cm. diametro, lineis atro-lavandulaceis conspicue ornatus. Segmenta perianthii clavata, lavandulacea, lanceolata, apicibus glandulosis, similia, subaequalia; sepalum dorsale circiter 2·0 cm. longum, retroflexum; segmenta cetera patentia. Labellum gracillime unguiculatum, fere transverse ovale, marginibus integris; lobi laterales magni, rotundati; lobus intermedius parvissimus, obtusum, recurvum, atro-purpureum; lamina nervis radialibus atro-lavandulaceis conspicuis ornata. Calli atro-pupurei, carnosi, stipitati, ad basin laminae in linea mediana conferti, prope unguem in laminis geminis duobus instructi. Columna basi retracta, incurva, dimidio superiore late alata, basi 2 glandulis luteis. Anthera subluteo-viridis, obtusissima.

A very slender species with the habit of *C. Roei*, Benth., but differing from that species in the segments of the perianth, in the conspicuous veining of the labellum and in the calli of the disc. Height in my specimen, 22·5 cm. Leaf narrow-linear, acute, hairy, channelled, 11 cm. long. Stem reddish, very slender, hairy, with a single slender subulate bract above the middle. Flower lavender, of medium size, nearly 5 cm. in diameter, conspicuously ornamented with radiating lavender lines. All segments of the perianth with conspicuously clavate dark glandular tips, lavender in colour, traversed by darker longitudinal lines, lanceolate, subequal in length and similar in shape; dorsal sepal about 2 cm. long, retracted backwards, the other segments spreading; petals rather narrower than dorsal sepal. Labellum mobile, very slenderly clawed, almost transversely oval in outline, with entire margins, large rounded lateral lobes; the middle lobe relatively very small, blunt, dark purple, recurved; lamina with conspicuous radiating dark lavender veins. Calli dark purple, fleshy, stipitate, compactly crowded along the posterior half of the middle line of the lamina as in *C. Roei*, Benth., at the very base of the lamina the calli enlarged and fused, so as to form 4 plates arranged didymously. Column at first retracted, then incurved, about 1·0 cm. long, widely winged in the upper half, 2 yellow glands at the base. Anther very blunt, greenish yellow.

Western Australia. Between York and Narrogin; Miss Winnie Dedman; end of September, 1926.

The new species, for which I am indebted to Mr. E. E. Pescott, differs from *C. Roei*, Benth., in the colour of the flower; in the clubbing and spreading of all perianth-segments, which are also subequal in length; in the very great disparity between the length of the dorsal sepal and the column; in the conspicuous veining of the labellum and the arrangement of the large calli at the base of the lamina.

In *C. Doutchae*, Sargent, the leaf is glabrous on the upper surface, but hairy on both sides in the new species. Also in the former only the lateral sepals are clavate, the other segments being finely acuminate and the apices of the petals circinate; the colour of the flower is greenish-red and the calli are long linear and very slender with little tendency to fusion and without the 4 conspicuous fleshy plates near the claw of the labellum.

C. lavandulacea, Rogers, and *C. Doutchae*, Sargent, appear to constitute members of a new Section, grouping themselves around *C. Roei*, Benth., and all

possessing an exceedingly wide, short labellum, with calli arranged in the posterior half of the median line of the lamina.

Caladenia alpina, Rogers, n. sp. Species terrestris, robustiuscula, circa 12-27 cm. alta. Caulis subruber, hirsutus, unibracteatus. Folium elliptico-lanceolatum vel falco-lanceolatum, suberectum, ad basin inflorescentiae vulgo attingens, leviter hirsutum, circa 0·6 cm.-1·0 cm. latum. Flores 1 vel 2, raro 3, vulgo nivei vel carnei; pedicelli graciles, longiusculi; bracteae acutae. Segmenta perianthii extrinsecus glandulosa, minute hirsuta. Sepalum dorsale late ovatum, cucullatum, multo incurvum, apice obtusum, 1·2 cm. longum, 0·9 cm. latum; sepala lateralia libera, elliptico-lanceolata, patentia circa 1·5 cm. longa, 0·6 cm. lata. Petala falco-lanceolata, patentia, 1·3 cm. longa, 0·6 cm. lata. Labellum breviter unguiculatum, obscure 3-lobatum, late ovatum, 0·9 cm. longum, 0·7 cm. latum, basi ad columnam erectum, versus apicem recurvum; lobi laterales obscuri, marginibus integris; lobus intermedius serratus, breviter triangularis; lamina notationibus transversis carneis vel punctis ornata; calli lineares, albi vel flavi, 4-seriati, prope apicem sensim sessiles. Columna sepalo dorsali obtecta, circiter 0·7 cm. longa, incurva, late alata. Anthera mucronata.

A moderately robust plant for the section to which it belongs, 12-27 cm. high, a cylindrical membranous sheath investing the base. Leaf usually reaching at least to the base of the inflorescence, elliptic-lanceolate to oblong- or falco-lanceolate, suberect, sparsely hirsute, ribbed, 5-10 mm. wide. Stem reddish, hairy; a loose or sheathing acute bract at or near the middle. Flowers usually 1 or 2, rarely 3; usually pale pink or steely-white; pedicels rather long and slender, subtended by an acute bract, the latter sometimes including a floral rudiment. Segments of perianth beset on the outside with minute glandular-tipped hairs. Dorsal sepal broadly ovate, cucullate, very much incurved over the column, blunt at the apex, about 9 mm. wide, 12 mm. long; lateral sepals free, elliptic-lanceolate, spreading, about 13 mm. long, 6 mm. wide. Labellum on a short claw, broadly ovate, about 9 mm. long, 7 mm. wide, partly hidden by the dorsal sepal, erect against the column in the lower three-fourths, thereafter recurved; lateral lobes erect, not well defined, their margins entire except for 2 or 3 small anterior crenulations; middle lobe shortly triangular, much recurved, dentate or serrate; lamina with transverse interrupted red or purple stripes or sometimes spotted; calli linear or golf-stick type, yellow or white, in 4 rows, gradually becoming sessile and irregular, extending almost to the tip; apex not very acute. Column hidden by the dorsal sepal, about 7 mm. long, dorsum red-spotted, incurved, rather widely winged. Anther incumbent, mucronate.

Victoria. Mount Hotham and Mount Bogong, Mr. A. J. Tadgell, December, 1921, January, 1924; Baw Baws, W. H. Nicholls, January 3, 1925.

New South Wales. Mount Kosciusko, Mr. G. V. Scammell, January, 1924.

Mr. Tadgell, to whom we are indebted for this alpine species, writes:—"It is fairly plentiful, but only on ridges or stony rises; sometimes sheltered, but more often in the open; sometimes 20 to 30 plants together, but usually only 2 or 3. Collected at an elevation of 5,000-5,500 feet."

Mr. Nicholls, who collected on the Baw Baws, states that the flowers never remain open for more than 2 days, and that in this station they are always white, "the petals on the outside with a pale purple line down the centre and very pale green shading on each side of it, on the inside all segments pure white. Labellum white except for yellow-headed calli and purple transverse markings. Column white with purple markings, the wings pale green near the stigma. Bracts dark purple, stem purple. Leaf dark green."

The new species approaches very closely to *C. cucullata*, Fitzg., and *C. angustata*, Lindl., in both of which, however, the leaf is narrow-linear. From the

former it is also to be distinguished by its long slender flower-pedicels, the markings on the labellum and absence of the fimbriated calli; and from the latter by its wide blunt and extremely incurved dorsal sepal and by the transverse markings on the lamina.

Caladenia carnea, R. Br. When we consider the extensive range of this well-known orchid, throughout the entire eastern half of Australia and as far north as Java, it is rather remarkable how persistently some of its minor characters are transmitted, and how otherwise trivial are the variations in regard to form and colour. Slight differences in the degree of acuteness of the perianth segments are often observed, and albino forms are not uncommon; occasionally also four rows of calli are to be found instead of two, but the transverse bars on the labellum and the markings on the column are rarely absent, and characterise even allied migrant forms, such as occur in Timor and New Zealand. Perhaps, however, the most notable variations have reference to size and development. The two extremes are represented by the pigmy form on the one hand, measuring from 3-5 cm. in height, and on the other, the vigorous plant which may attain a height of 53 cm., and perhaps more. Such extreme variations are to be found in my folders with a considerable degree of frequency, and do not appear to depend on nutritional factors, as in this State at all events, their occurrence is very localised and the pigmies are to be found growing in small colonies in the immediate vicinity of ordinary individuals, which measure from 10-15 cm. high.

I have received these diminutive forms from other States, and am of opinion that they, as well as the giant forms, are sufficiently important to be recognised as varieties.

C. carnea, R. Br. var. **pygmaea,** Rogers, n. var. An extremely slender plant, from 3-5 cm. high, with flowers much smaller than in the type.

South Australia. Scott's Creek, Dr. and Mrs. Rogers, November 13, 1908.

Victoria. Healesville, Mrs. Coleman and Mr. Williamson, November 2, 1923; Mr. J. B. Howie, October 10, 1926.

Tasmania. Flinders Island, Dr. C. S. Sutton, November, 1912.

C. carnea, R. Br., var. **gigantea,** Rogers, n. var. A sparsely hairy plant, attaining a height of 53 cm., flower larger than in the type, perianth segments rather acute.

New South Wales. Bulladelah, Rev. H. M. Rupp, September, 1924.

ABORIGINAL ROCK PAINTINGS, SOUTH PARA RIVER, SOUTH AUSTRALIA.

By Norman B. Tindale and Harold L. Sheard.

[Read November 11, 1926.]

Plates I. and II.

This paper places on record several relics of aboriginal art in rock shelters along the course of the South Para River between Yatalunga and Gawler.

We recently examined the river for a distance of 10 miles, in company with Mr. P. Stapleton. Many shelters were noticed, four of which contain paintings, the pigments used being red, white, and black only. Two of this series of shelters, namely, the upper and lower ones at Yatalunga, have already been recorded by the late Sir Edward Stirling[1] and by the late Mr. F. R. Zietz.[2] The Upper Yatalunga shelter is situated on the northern bank of the river in a conspicuous position at the lower end of a river flat about 4 chains above the junction of Tenafeate or Stars' Creek (Section 1786, Hundred of Barossa). Most of the paintings have been figured by Stirling, but several are shown again for comparison with new discoveries. Text figs. 14-21 represent tracings (reduced by *camera lucida* to about one-sixth natural size); No. 21, in white pigment, is rather indefinite and may be due in parts to weathering action.

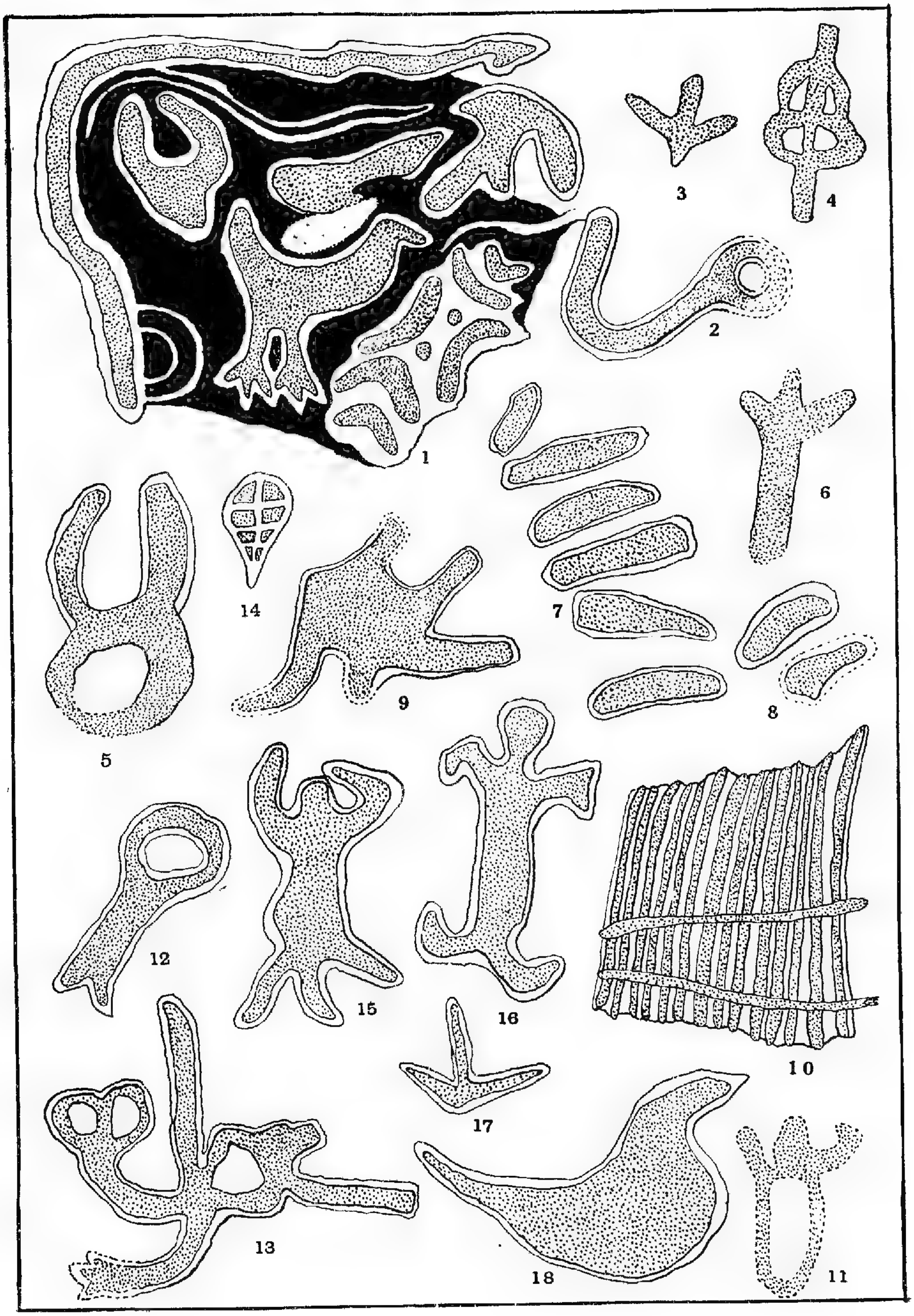
On the floor, which had been previously disturbed, were found several hammer stones showing definite but slight signs of use. Zietz *(l.c.)* records having found emu egg-shells and the jaw of a bandicoot in the floor of one of the shelters at Yatalunga. The talus in front of the shelter yielded emu egg-shells and several mussel shells *(Unio angasi)*. A few quartz chippings were found here; one example, although crude, was evidently intended for a round scraper. Interspersed with the earthy *débris* were regular layers of charcoal, going down at least 2 feet, showing that the slope had been used for camping purposes on various occasions and had not been previously disturbed.

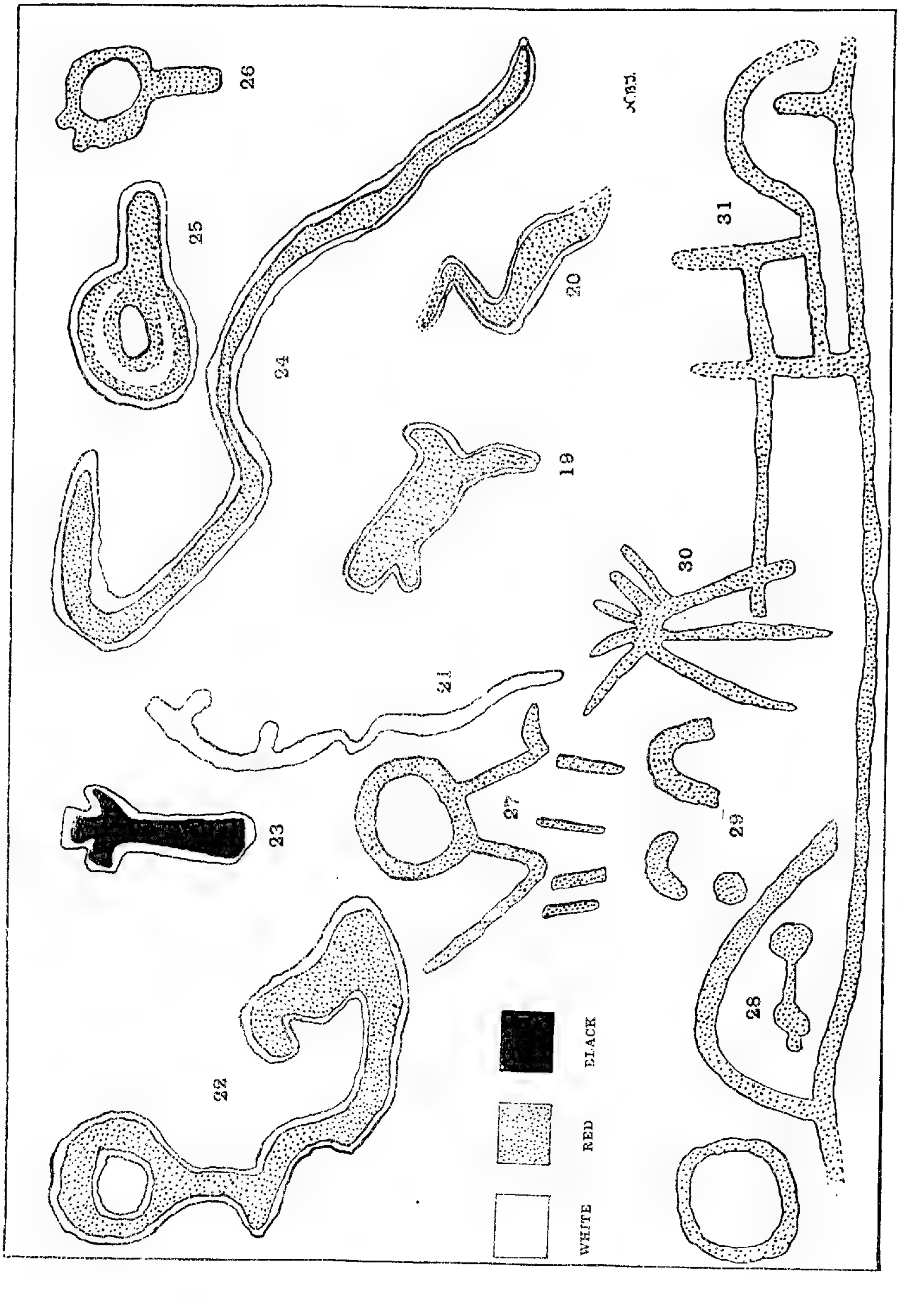
The lower shelter is about 150 yards down stream on the same bank. Entrance is gained up a steep slope of about 25 feet. Detritus and large slabs of slate have fallen from the roof, probably in recent years, so that no paintings now remain in the eastern half of the shelter. Pl. i., fig. 1, shows many of the paintings. Reduced tracings are shown in text figs. 1-13. Stirling figured only four of these, namely, Nos. 3, 4, 9, and 13, and we disagree with the rendering of some of these.

Text fig. 1 shows a complicated group of designs executed partly on a black background; the figures being in black and red outlined in white. Several striking examples are noticeable, the central figure being that of a bird, probably an emu. The bird is partially framed by a painting having some resemblance to a snake, and there is a boomerang design on the other margin. The white area in the centre represents a weathered portion of the rock. The application of the white over black has tended to flake off the whole of the pigment, leaving the white lines in part represented by the bare rock surface. Text fig. 2 is shown in its proper position to the right of fig. 1. The characteristic circle and line, the latter either curved or straight, is repeated several times in this and other caves. Text fig. 5 is situated on the roof of the small hole shown on the extreme left of

(1) Stirling, Sir E., Trans. Roy. Soc. S. Austr., 26, 1902, pp. 208 211, pls. 3, 4.

(2) Zietz, F. R., Trans. Roy. Soc. S. Austr., 41, 1917, p. 667.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18



19
20
21
22
23
24
25
26
27
28
29
30
31
WHITE
RED
BLACK

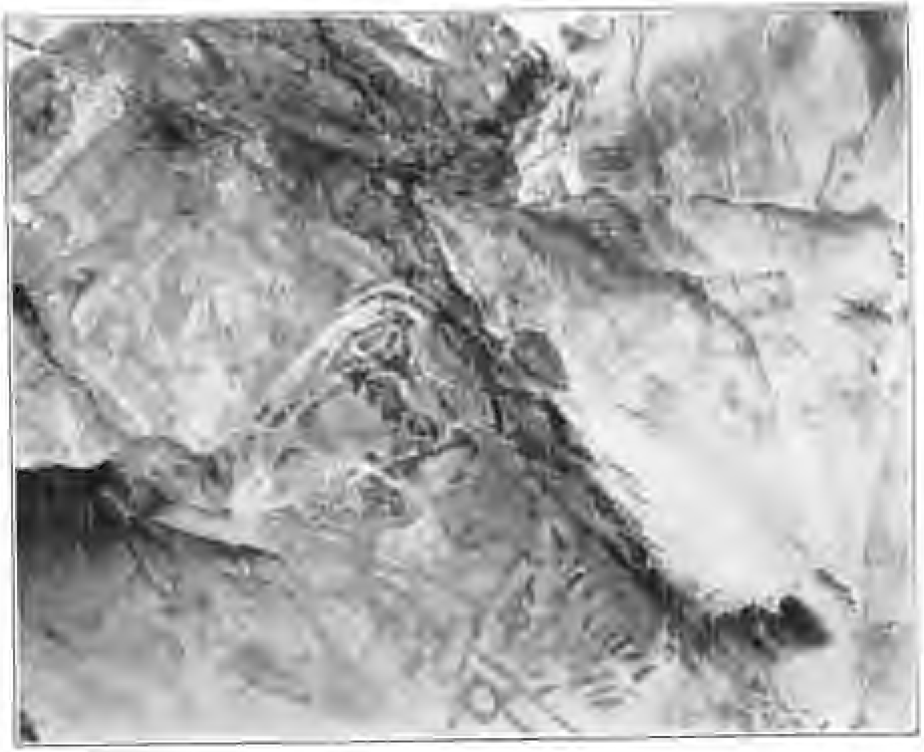


Fig. 1.

Fig. 2.

Fig. 1.

Fig. 2.

Gillingham & Co. Limited, Printers, Adelaide.

pl. i., fig. 1. Text fig. 6 probably represents a bird track or foot. Figs. 7 and 8 are the more definite pictures on a badly weathered portion. Text fig. 10 represents a series of nearly vertical parallel lines which are alternately red and white and are crossed by at least two red bands. Text fig. 11, which is badly weathered, may represent a human foot or track. Text fig. 12 shows another example of the circle with an appendage.

The third shelter is situated about three miles from Yatalunga on the left or northern bank just below the big ox-bow bend near Waters' homestead (Section 1033, Hundred of Munno Para). The bank here is somewhat precipitous, and the shelter, which is well hidden from casual observation, opens out on to a ledge about 30 feet above the stream (pl. ii., fig. 1). It is 20 feet wide, 7 feet high at the entrance, with an overhang of about 10 feet. Only seven drawings occur here, but at least three are well preserved and remarkably vivid in colour. Text fig. 22 has the form of a circle with a long appendage; it is executed in red outlined with white, and contrasts strongly with fig. 23, which is in close proximity. The latter is of similar form to text fig. 6, but is unusual in being black. Text fig. 24 is snake-like in outline and similar in some respects, including length, to that shown in text fig. 1. Figs. 25 and 26 are further examples of the circle and line; both are badly preserved and the outlines are approximate. Text fig. 27 is much faded and has been traced from a sketch. It represents a circle with two V-shaped appendages above four nearly vertical short strokes.

From the floor of this shelter Mr. P. Stapleton dug several quartz chippings, including one very imperfect scraper; there were numerous river pebbles interspersed with charcoal in the *débris*, and, as in the Yatalunga shelters, *Unio* shells were common.

The fourth shelter is within two miles of Gawler, on the northern bank; four similar cavities occur here, but only one contains designs. These are indistinct and only red ochre patterns are visible; the camera shows, however, that formerly they were outlined in white, as in the previous examples. Pl. i., fig. 2, shows the best preserved portion of the design, and text figs. 28-31 the whole of the work. At one end there is a plain red circle. Text figs. 28, 30, and 31 are connected by continuous red lines, which fade away to the right. Fig. 30 may represent the framework of a native hut, and the horse-shoe shaped marks of fig. 29 are similar to those said to represent wurleys or huts, in northern rock paintings.

Little information is available regarding the natives who inhabited the locality. The Wirra tribe, or local group of the Adelaide tribe, ranged over the country between Angaston, Lyndoch, Port Adelaide, Yatala, and Tea-Tree Gully, and its members were probably responsible for the rock paintings. The name Yatalunga is probably derived from the words yertala unga, meaning "flood place," and the name Yatala has evidently a similar derivation.

About three miles above Gawler there is a camp site where a few crude hammer stones and quartz chippings were found.

DESCRIPTION OF PLATES I. AND II.

PLATE I.

Fig. 1. Lower rock shelter at Yatalunga.
Fig. 2. Rock paintings near Gawler.

PLATE II.

Fig. 1. Waters' rock shelter viewed from up stream.
Fig. 2. Rock paintings at Waters' shelter.

ABORIGINAL ROCK CARVINGS AT DEVON DOWNS, RIVER MURRAY, SOUTH AUSTRALIA.

By Harold L. Sheard.

[Read November 11, 1926.]

Plates III. to V.

This paper records a series of aboriginal carvings on the Lower Murray. With the single exception of a brief note by Hale and Tindale[(1)] nothing has previously been reported from this locality, but in my opinion a thorough search of the cliffs between Mannum and Swan Reach would reveal further examples of this type of aboriginal art.

The situation of the rock shelter herein described is about the border-line of the Hundreds of Nildottie and Forster, on the eastern bank of the Murray, and may also be located from the river immediately opposite Lehmann's Landing. Approaching by road it is about 12 miles from Swan Reach following down stream. An entrance can be made from the road to the river flats except at flood times and a car may be driven to within a chain of the rock shelter. There is a slight bend in the river and the main channel leaves the cliffs at this point. The shelter is at the extreme end of a series of river flats, and a little further up stream the cliffs rise sheer from the water.

The shelter is the result of erosion, probably when the river was at a higher level, and extends to 70 feet in length, with an overhang of 16 feet in the deepest place. The floor to a depth of 3 feet is composed of ashes from old fires and a small amount of detritus from the cliff. This on being partially examined was found to contain quantities of bivalve shells *(Unio angasi)*, kernels of the native peach *(Santalum acuminatum)*, bones of the Murray cod *(Oligorus macquariensis)*, many broken fragments of burnt stones, and small animal bones. One crude upper millstone and a few rough flakes were observed, these being the only native implements discovered. The height from the present surface of the floor to the roof varies from 3 feet to 7 feet. The whole of the roof and the walls are smoke-blackened, and a grey tinge ascends right to the top of the cliffs. This smoke stain, while often much weathered, is a good guide to aboriginal occupation; wherever the cliffs show blackened markings, the ground beneath shows signs of former aboriginal habitation.

Pl. iii., fig. 1, shows the shelter from the north, and in fig. 2 the camera was facing directly into the cave in a north-easterly direction. The rock is a soft fossiliferous limestone of Miocene age, and may be easily scratched or carved with any hard implement. Portions of the original surface most exposed to the weather have been eroded, and in several places complete intaglios have been recently hewn from the rock. Everywhere within reach has been carved by the natives, the marks varying from mere scratches to cuts from 1 inch to 2 inches wide and about an inch deep. The work appears to have been executed many years ago, and the natives at present at Swan Reach on being questioned had no knowledge of the place.

Few of the intaglios are complete pictographs, but are mostly connected one with the other by long curving lines which radiate in all directions. Pl. iv., fig. 1,

(1) Hale, H. M., and Tindale, N. B., Records of South Australian Museum, iii., No. 1, 1925, pl. iv., fig. 4.

Fig. 1.

Fig. 2.

Gillingham & Co. Limited, Printers, Adelaide.

Fig. 1

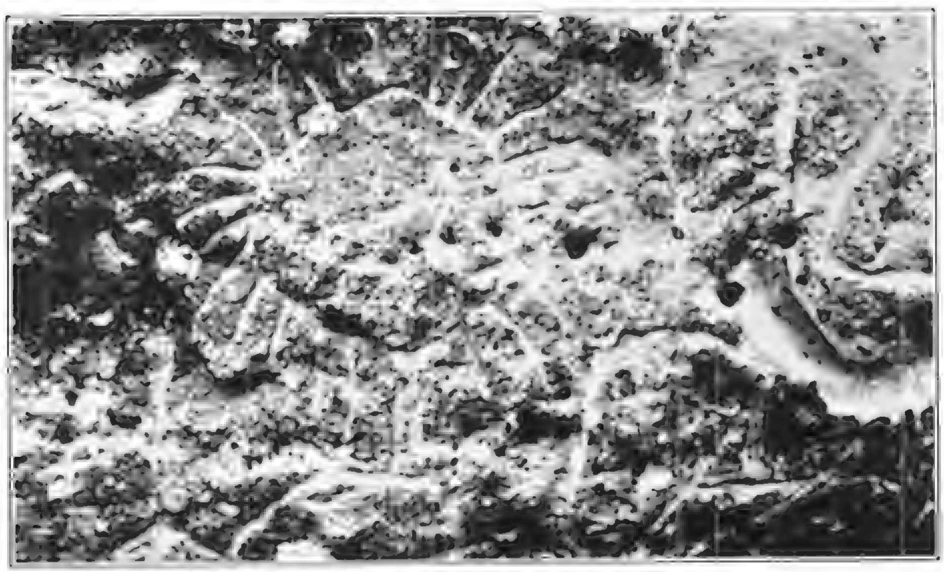


Fig. 2

Gillingham & Co. Limited, Printers, Adelaide.

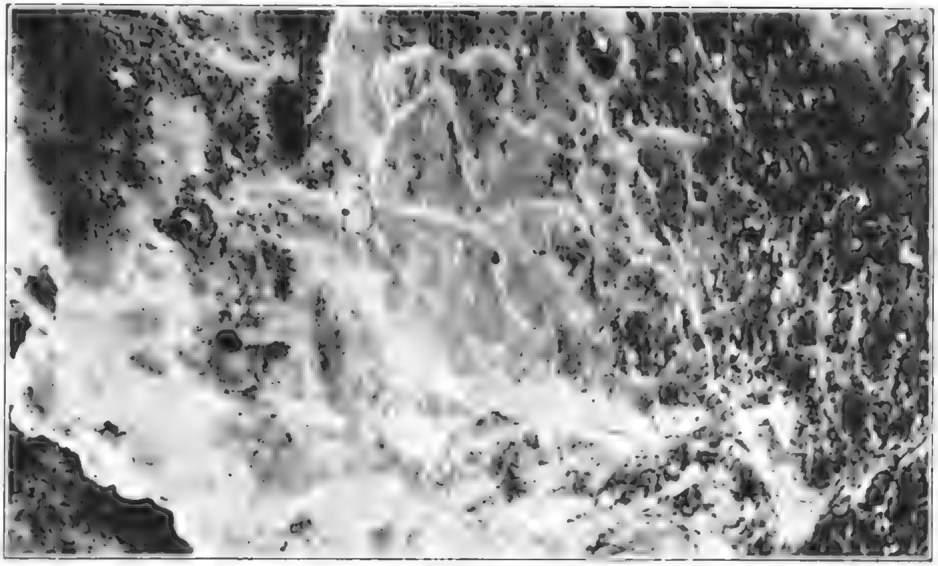


Fig. 1

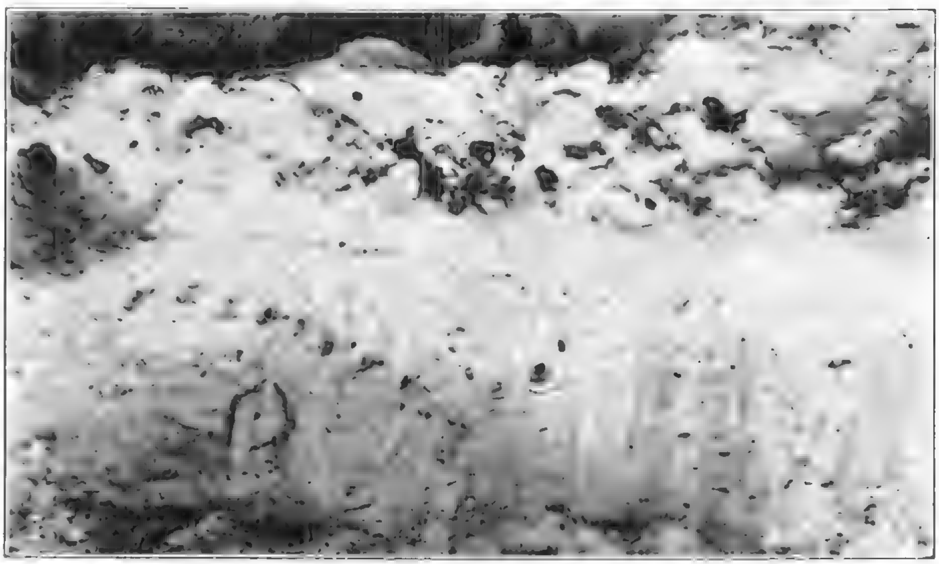


Fig. 2

Gillingham & Co. Limited, Printers, Adelaide

shows a portion of the ceiling about 6 feet by 4 feet, and is typical of much of the work. A good idea of proportion will be gained by a comparison of size with the nests of the Fairy Martin *(Petrochelidon ariel)* shown in this plate. Natural holes and excrescences have frequently been used and accentuated in the designs. Series of short parallel strokes and rows of round holes were observed in several places, as seen in pl. v., fig. 2. The intaglio in pl. iv., fig. 2, is situated on the cliff face near the centre of the shelter. The irregular circle therein is 15½ inches in diameter with radiating lines which vary from 4 inches to 6 inches in length. The deep cut on the right of this plate is due to a recent abandoned effort to hew away a portion of the rock. Pl. v., fig. 1, is located at the southern end of the shelter, and is so placed as to extend from the cliff face to right under the roof, and then continue in the usual curved lines. The actual pictograph measures 39 inches in length, and is a series of lines and holes with a decided node about the centre. This intaglio may be clearly seen in pl. iii., fig. 2, at the top and a little to the left from the centre of the plate.

The design shown in pl. v., fig. 2, is situated beyond the southern end of the shelter on the cliff face, and was partially outlined in chalk for the photograph. The central figure measures 8 inches, the circle therein 3½ inches in diameter, and a hole bored in the centre 3 inches deep. The vertical lines on each side measure from 6 inches to 9 inches in length and terminate in small round holes.

Carvings fern-like in outline similar to those previously reported by Hale and Tindale [see footnote (1)] were also observed at this place.

The cliff face was examined on both the north and south sides from the shelter. On the northern side many scratchings and holes were observed, bird tracks being prominent; but the work here was more exposed to the weather, and only a few places remained where large surfaces were complete; these did not appear to present the care and minuteness of detail noticed within the shelter. Fires had been frequent and the old rock surfaces were smoke-stained.

On the southern side the cliff retreats from the river and about 3 or 4 chains from the shelter merges into a rough weathered limestone boulder formation. Two other cavities were examined here, but these were so situated as to be more exposed to the weather, and very little of the original surface remained. A few scratchings were observed but no carvings of importance. Both these shelters contain huge beds of ashes about 3 feet deep, but a superficial search revealed nothing of consequence.

On the opposite side of the river sand drifts have exposed old camp sites and burial grounds where skeletal remains were observed.

DESCRIPTION OF PLATES III. TO V.

PLATE III.

Fig. 1. Rock shelter opposite Lehmann's Landing, looking south.
Fig. 2. Interior of rock shelter opposite Lehmann's Landing.

PLATE IV.

Fig. 1. Portion of roof of shelter.
Fig. 2. Pictograph on cliff face.

PLATE V.

Fig. 1. Pictograph on roof of shelter.
Fig. 2. Pictographs on wall of shelter.

PETROGRAPHIC NOTES ON TONALITE FROM THE PALMER DISTRICT AND BIOTITE-NORITE FROM SOUTH BLACK HILL.

By A. R. ALDERMAN, B.Sc.
(Communicated by C. T. Madigan.)

[Read November 11, 1926.]

The rocks described in this paper occur within the County of Sturt, South Australia. As the characters of the rocks are very unusual among the igneous rocks of the southern part of this State, they were deemed worthy of chemical analysis and petrographical description.

I. In Section 380, Hundred of Finnis, a whale-back outcrop of light-coloured igneous rock of syenitic facies may be observed adjacent to the main road, roughly half-way between the townships of Mannum and Palmer. The same rock may be traced for a considerable distance south of this locality (the outcrops being very poor), and occurs in a much more prominent manner at a waterfall in Reedy Creek, Section 533, Hundred of Finnis. Owing to the geographical position and unusual mineral composition of this rock, when compared with the neighbouring granites at Palmer and Mannum, notes on the petrographical character should be of interest.

In Section 380, whence the specimens, here described, were obtained, the outcrop measures roughly 40 yards across, and shows definite jointing in a north and south direction.

When examined in the hand specimen the rock appears coarsely holocrystalline of somewhat porphyritic habit. Large white felspars, often tabular, are prominent, and, with the black ferromagnesian minerals, give the rock a handsome appearance. Granular quartz seems to show the effects of crushing. The ferromagnesian minerals are of two distinct kinds, which are of about equal importance. Black biotite mica may readily be recognised on account of its cleavage and lustre, but well-formed, tabular crystals of black hornblende, measuring up to half a centimetre, are equally prominent. Small crystals of a red colour, resembling sphene, are occasionally visible.

MICROSCOPICAL DESCRIPTION.

The rock is coarse and holocrystalline, and the crystal components are of very variable size. The felspars are by far the most plentiful minerals present in the rock.

Plagioclase is dominant over potash felspar, and being dusty, is decomposed to a varying extent. The twinning is almost entirely on the albite law, although occasional Carlsbad twins are present. Extinction angles determined in a plane perpendicular to 010 give the composition of the plagioclase as Ab_{64} An_{36}, or a normal andesine. The refractive index is higher than that of Canada Balsam. The composition of the plagioclase seems to be constant throughout the section.

Orthoclase is present but to a far less extent than the plagioclase. Many sections of the former have suffered extreme kaolinisation. The orthoclase is always present in subhedral or anhedral forms, and the dimensions of the individuals are less than those of the plagioclases.

Microcline is represented by a few small crystals which show the characteristic cross hatching, due to both pericline and albite lamellae.

After the felspars *quartz* is the most important mineral in the rock. It occurs irregularly in grains and generally shows the effects of severe strain, the extinction being shadowy. For the most part the quartz appears to be interstitial, but it very rarely shows a graphic intergrowth with the plagioclase felspar.

Of the ferromagnesian minerals biotite and green hornblende are present in approximately equal proportions.

The *biotite* shows no particular orientation and is present in its usual flaky form. The pleochroism is normal and strong. In some sections the biotite has, in part, undergone change to chlorite, which is light green and pleochroic, and retains the micaceous cleavage. Pleochroic haloes, surrounding minute crystals of apatite, are occasionally to be observed in the cleavage flakes.

Primary, green *hornblende* is present in euhedral or subhedral crystals, which show the cleavage net characteristic of hornblende, and also marked pleochroism. Occasional crystals are twinned. This mineral appears to have been very resistant to decomposition, but a very small amount of chlorite, evidently derived from the hornblende, may occasionally be found connected with that mineral.

Titaniferous iron occurs in irregular masses and is evidently a primary constituent of the rock, although a small amount seems to be associated with the chloritization of the ferromagnesian minerals. That the iron is titaniferous is proved by the change to leucoxene.

Apatite as an accessory mineral is plentifully distributed, both as irregular grains and rods, and occasional hexagonal crystals. Very often the apatite is enclosed by biotite or hornblende.

Sphene is a notable constituent. In the hand specimen it appears in reddish crystals, with occasional wedge-shaped outlines. Microscopically, it is present in subhedral fragments, with occasional euhedral crystals of a light-brown colour. A weak pleochroism is shown.

The Chemical Analysis.

	Percentage.		Percentage.
Silica (SiO_2)	63·88	Water (combined)	0·45
Alumina (Al_2O_3)	16·37	Water (hygroscopic)	0·21
Ferric oxide (Fe_2O_3)	1·99	Carbon dioxide (CO_2)	None
Ferrous oxide (FeO)	2·96	Titanium dioxide (TiO_2)	0·86
Magnesia (MgO)	2·24	Phosphorus pentoxide (P_2O_5)	0·23
Calcium oxide (CaO)	5·18	Manganous oxide (MnO)	0·07
Soda (Na_2O)	3·66		
Potash (K_2O)	1·61	Total	99·71

The specific gravity is 2·792.

The Norm.

	Percentage.		
Quartz	21·66	Q = 21·66	Salic Group = 85·66%
Orthoclase	9·45	F = 64·00	
Albite	30·92		
Anorthite	23·63		
Diopside	0·89	P = 8·43	Femic Group = 13·46%
Hypersthene	7·54		
Magnetite	3·02	M = 4·69	
Ilmenite	1·67		
Apatite	0·34	A = 0·34	
Water	0·66		
Total	99·78		

In the C.I.P.W. classification, the rock is therefore II., 4, 3, 4. The magmatic name is *Tonalose.*

Discussion of the Analysis.

As might have been expected from the general nature and appearance of the rock, it is not quite acid enough to be classed in the Acid Group. The high percentage of lime, a considerable quantity of which evidently forms part of the hornblende, and the low potash content, gives the dominance of calc-alkali felspar over potash felspar. Titanium has a high percentage, but with a rock containing notable amounts of titaniferous iron and sphene, this should be expected.

From the chemical nature of the rock, the dominance of andesine felspar over the potash varieties, and the presence of notable quantities of biotite and hornblende, the rock must be classed with the quartz diorites, and may thus be referred to as a *Tonalite.*

II. In Section 240, Hundred of Ridley, at the locality known as the South Black Hill, a stock of *biotite norite* forms a very prominent feature of the landscape. This rock occurs as an inlier in the surrounding Tertiary and alluvial, and unfortunately no contact rocks can be observed. The character of the rock over all the outcrop is very uniform, and only one specimen (not *in situ)* was collected which showed any variation from the main mass.

The mineralogical character of the rock has been briefly described by Dr. C. Chewings,[1] but owing to the striking nature of the rock it deserves more detailed investigation.

When examined macroscopically the rock is coarsely crystalline, melanocratic, and of hypidiomorphic texture. Minerals distinguishable are (1) black pyroxene and iron ore, (2) felspar, (3) biotite mica.

Microscopical Examination.

The most plentiful mineral in the rock is the pyroxene *diallage.* It is of a light-green colour with weak pleochroism, and contains numerous inclusions of magnetite which are mostly arranged parallel to the cleavage. Also included in the diallage are small fragments of biotite and rods of apatite. Chlorite is present as a decomposition product.

Hypersthene is very nearly as plentiful as diallage and shows a distinct pink to green pleochroism. This mineral has been somewhat decomposed to a fibrous aggregate of bastite. Inclusions of magnetite, apatite, and biotite are common. The hypersthene evidently crystallised before the diallage. It occasionally shows lamellar twinning due to intense strain.

Of the felspars *plagioclase* is predominant, and the maximum extinction angles observed on a plane normal to 010 give the composition as a labradorite. This mineral exhibits the usual polysynthetic twin lamellae, following the albite law.

Carlsbad twins are also of frequent occurrence. The effects of strain are shown by bending of the albite lamellae, and the development of "secondary twinning."[2] The dusty appearance of the felspars is due to slight decomposition.

Orthoclase is mainly interstitial and gives a shadowy extinction. It contains numerous inclusions and was the last mineral to crystallise.

Biotite is present in its usual platy form, but occasional radiating and plumose aggregates are visible in the section. The biotite is intimately associated with, and mostly includes, opaque iron ore. The pleochroism is very strong, and some sections show complete absorption.

[1] C. Chewings, Beitrage Zur Kenntniss Geologie Süd-und Central-Australiens, Petrographischer Anhang, Heidelberg, 1894, p. 39.

[2] Judd, Q.J.G.S., 1885, pp. 363-366.

Ilmenite, in large grains, is very plentiful, and is included in most of the ferromagnesian minerals. It exhibits decomposition to *leucoxene*. Ilmenite was probably the first mineral to crystallise.

Apatite in subhedral crystals is a very frequent accessory.

This description agrees in almost every respect with that of Chewings.

The Chemical Analysis.

	Percentage.		Percentage.
Silica (SiO_2)	53·37	Water (hygroscopic)	0·22
Alumina (Al_2O_3)	14·25	Carbon dioxide (CO_2)	None
Ferric oxide (Fe_2O_3)	2·55	Titanium dioxide (TiO_2)	1·70
Ferrous oxide (FeO)	7·44	Phosphorus pentoxide (P_2O_5)	1·24
Magnesia (MgO)	5·04	Ferric disulphide (FeS_2)	Trace
Calcium oxide (CaO)	8·87	Manganous oxide (MnO)	0·15
Soda (Na_2O)	2·50		
Potash (K_2O)	2·96		
Water (combined)	0·19	Total	100·48

The specific gravity is 3·128.

The Norm.

	Percentage.		
Quartz	3·84	Q = 3·84	Salic Minerals = 61·22%
Orthoclase	17·79	F = 57·38	
Albite	20·96		
Anorthite	18·63		
Diopside	14·56	P = 29·13	Femic Minerals = 38·72%
Hypersthene	14·57		
Ilmenite	3·19	M = 6·90	
Magnetite	3·71		
Apatite	2·69	A = 2·69	
Water	0·41		
Total	100·35		

In the C.I.P.W. classification the rock is therefore III., 5, 3, 3.

The magmatic name is *Shoshonose-Kentallenose*.

Discussion of the Analysis.

The analysis shows several points of interest, of which the most notable feature is the comparatively high potash content. This may, however, be accounted for, firstly, in the orthoclase, and secondly, in the biotite, which may contain up to 10 per cent. of potash. Silica appears higher than would be expected in such a rock, and the high percentages of titanium and phosphorus are also notable.

AN ENUMERATION OF THE VASCULAR PLANTS OF KANGAROO ISLAND.

By J. B. Cleland, M.D., and J. M. Black.
(Orchids by R. S. Rogers, M.A., M.D., F.L.S.)

[Read April 14, 1927.]

The present contribution is a list with localities of the recorded vascular plants of Kangaroo Island, with the nomenclature brought up to date so as to conform with the new Flora of South Australia now nearing completion, and with the addition of a number of species (about 79 in number) not hitherto recorded for this locality. No attempt is made in this paper to discuss the peculiarities or affinities of the plants of this region. This list is merely the "jumping-off ground" brought up to date for workers on the ecology and other aspects of the vegetation.

To the late Professor Ralph Tate we owe most of our systematised knowledge of the plants of Kangaroo Island. He, Dr. R. S. Rogers, and the late J. G. O. Tepper have been its most extensive botanical collectors. The work of our predecessors has been incorporated in this list. It is therefore advisable to show what this work was and how we have utilised it. Our starting point has been Professor Ralph Tate's paper on "The Botany of Kangaroo Island" in these Trans., vi., 1882-3, pp. 116-171. He has summarised the work of his predecessors, Robert Brown, the Baudin Expedition, Messrs. Sealey, Bannier, and Heuzenroeder, and Mr. F. G. Waterhouse. These workers were responsible for recording 160 species of plants. Tate's first list brought the total up to 350 with 40 additional introduced species. To these Trans. for 1888-9 (xii., pp. 62-66) Tate contributed "A Revision of the Flora of Kangaroo Island and other Botanical Notes relating thereto," which brought the known native species to 513. Tate's records, including those of his predecessors, appear in this paper thus (R. T.), the name of his predecessor where necessary appearing in brackets after the locality.

Tepper contributed three papers on this subject to these Trans., *viz.*, vii., 1883-4, pp. 50-53; ix., 1885-6, pp. 114, 115; and x., 1886-7, pp. 288-292. The species were identified for him by Baron von Mueller. Tate revises some of the determinations in his second paper. Tepper's records appear as (Tepper). Tepper's extensive collection of plants, including many of those gathered on Kangaroo Island, is now in the possession of the Field Naturalists' Section of this Society, to whom we are indebted for permission to examine them. Localities unrecorded otherwise and based on these herbarium specimens appear as (Tepper Herb.).

The late J. H. Maiden, in "A Contribution to the Botany of South Australia" (these Trans., xxxii., 1907-8, pp. 252-258), gave a number of localities, and a few new records, and described a new species. (J. H. M.) indicates this source. Dr. R. S. Rogers (these Trans., xxxiii., 1908-9, pp. 11-17) brought the knowledge of the orchids of the Island up to date and described two new species. To him we are indebted for revising the list of orchids and supplementing the published list with his records since that date. We are also greatly indebted to him for allowing us to use his typescript, "Flora of Kangaroo Island," with its additional MSS. notes, in compiling the present list. Apart from the orchids, his extensive collections on the Island were in many cases identified either by Ralph Tate or by J. H. Maiden. (R. S. R.) indicates this source of information.

One of us (J. M. B.) has recorded and described various species and varieties of plants from the Island in his "Contributions to the Flora of South Australia" appearing in these Trans. These, together with plants collected by Prof. T. G. B. Osborn, one of us (J. B. C.), and other collectors, which have been identified by J. M. B., are responsible for records of the locality "Kangaroo Island" in the new "Flora of South Australia," in those cases where such species have not previously been recorded for Kangaroo Island by others. We are specially indebted to Prof. Osborn, who has made extensive collections of plants on Flinders Chase, at the western end of the Island, in his study of the ecological aspects of the flora, for enabling us to make use of his material. Much of his collecting is embodied in the new Flora, but further additions of localities appear under his name. This list will, we hope, aid him in his special studies. One of us (J. B. C.) has had two opportunities of collecting in the western half of the Island—with Dr. R. S. Rogers in November, 1924, and with Dr. A. Lendon in March, 1926. This has enabled a number of localities to be tabulated, has added about 52 species of native plants, as well as 21 species of introduced plants, to the flora, and has resulted in the discovery of two, probably three, new species, necessarily, as yet at least, confined to Kangaroo Island. The following list shows that the vascular plants of Kangaroo Island now total:—

653 native species, of which 8 are doubtful, with 19 additional varieties, and 72 introduced plants, with 1 additional variety. Introduced plants are indicated by *, new records (mostly found by one of us) by x or †. As, in the much smaller district of Encounter Bay, nearly 530 native species are now known to occur, it may be considered certain that many more native species than the 653 included in this list will be eventually found on Kangaroo Island. We might hazard the guess that further exploration will reveal a total of about 750.

The localities given for a particular species, and the number of collectors who have recorded it, are in a measure indicative of its geographical distribution and abundance. In a number of cases, it will be seen that a plant has only been recorded as having been found on one occasion. This usually indicates that the species is rare, perhaps nearing extinction, unless in some of the earlier records it be due to a misdetermination.

In the present paper, there has been a division of labour between the authors. Dr. R. S. Rogers has kindly revised the orchids, J. B. C. has been responsible for the gathering together of previous records which have then been revised by J. M. B. The former's collections on the Island, totalling approximately 350 native species (including varieties) and 39 introduced, have been in great part examined by the latter. New records have thus passed under the view of the second author.

Plants for Kangaroo Island.

x, new record; *, introduced.

Filicales.

x*Lindsaya linearis*, Swartz.—(J. B. C.) Rocky River, telegraph line to Cape Borda.

Adiantum aethiopicum, L.—(R. Brown) K.I.; (R. T.) Stun' Sail Boom River; (Tepper Herb.) Karatta (13/11/86); (R. S. R.) Western River; (J. B. C.) S.W. River.

Cheilanthes tenuifolia, Swartz.—(R. T.) American River, North Dudley Peninsula, Deep Creek, Hog Bay River, De Mole River; (J. B. C.) Vivonne Bay.

Pteridium aquilinum, (L.) Kuhn.—(R. T.) Western Cove, American River, Harriet and Stun' Sail Boom Rivers, De Mole River; (J. B. C.) near Kingscote, Middle River, Ravine des Casoars.

Blechnum discolor, (Willd.) Keys.—(R. T.) Stun' Sail Boom River, De Mole River.

B. capense, (L.) Schlecht.—(R. T.) Stun' Sail Boom River; (Tepper Herb.) Ravine des Casoars; (J. B. C.) Ravine des Casoars.

Gymnogramme leptophylla, (L.) Desv.—(R. T. as *Grammitis leptophylla)* Deep Creek and gullies on N.W. coast of Dudley Peninsula.

?x*Gleichenia circinata,* Swartz, doubtful records only.—(J. B. C.) Mouth of Breakneck River *(teste* Mr. May), young plants (?) at the ford between Vivonne Bay and Rocky River.

Schizaea fistulosa, Labill.—(Tepper) Head of S.W. River.

Ophioglossum coriaceum, A. Cunn.—(R. T. as *O. vulgatum,* L.) Karatta (coll. Tepper); (Tepper Herb.) Capsize Creek (4/11/86).

LYCOPODIALES.

Lycopodium laterale, R. Br.—(R. T.) Head of South-west River (coll. Tepper).

Phylloglossum Drummondii, Kunze.—Flinders Chase, swamp near Rocky River (T. G. B. O.).

Selaginella Preissiana, Spring.—(R. T.) Murray Lagoon and Karatta (coll. Tepper).

Isoetes Drummondii, A. Br.—Flinders Chase, swamp near Rocky River (T. G. B. O.).

12. PINACEAE.

Callitris cupressiformis, Vent., var. *tasmanica,* Benth.—(R. T. as the type) Four miles from Cygnet River towards Birchmore Lagoon; (J. B. C.) Rocky River.

C. robusta, R. Br.—(R. T. as *C. verrucosa)* Hog Bay River to American Beach and American River, Western Cove, Bay of Shoals; (J. H. M. as *C. propinqua)* Hog Bay.

13. TYPHACEAE.

Typha angustifolia, L.—(Tepper) South-west of Karatta (Harpur); (J. B. C.) Cygnet River.

14. POTAMOGETONACEAE.

x*Zostera nana,* Roth.—(J. B. C.) Kingscote.

?x*Z. tasmanica,* Martens.—(J. B. C.) Kingscote.

Althenia Preissii, (Lehm.) Graebn.—(Tepper as *Lepilaena Preissii)* Karatta.

x*Cymodocea antarctica,* (Labill.) Endl.—(J. B. C.) Middle River.

x*Posidonia australis,* Hook. f.—(J. B. C.) Bay of Shoals, very broad leaves, washed up, possibly a new species, Middle River (ordinary leaves), Pennington Bay (very narrow leaves).

Potamogeton ochreatus, Raoul.—(R. T. as *P. obtusifolius)* Cygnet River; (J. B. C.) Lower Cygnet River (Feb.).

P. pectinatus, L.—(R. T.) Cygnet and Eleanor Rivers.

P. Tepperi, A. Benn. in Tate's Census for K.I.—(R. T.) *P. natans* for Lower Cygnet River and Stun' Sail Boom River presumably refers to Tate's later reference in the Census to *P. Tepperi;* (Tepper) Cygnet and Stun' Sail Boom Rivers.

x*P. tricarinatus,* A. Benn.—(T. G. B. O.) Harriet River; (J. B. C.) Cygnet River.

Ruppia maritima, L.—(R. T.) Cygnet, Eleanor, and Hog Bay Rivers, Deep Creek; (Tepper as *Vallisneria, teste* Tate) Karatta.

17. SCHEUCHZERIACEAE.

Triglochin striata, Ruiz et Pav.—(R. T.) Cygnet, Eleanor, Stun' Sail Boom, and Hog Bay Rivers.

T. mucronata, R. Br.—(R. T.) For K.I. in Fl. Austr.

T. centrocarpa, Hook.—(R. T.) N.W. Dudley Peninsula.

T. procera, R. Br.—(R. T.) Cygnet, Eleanor, and Stun' Sail Boom Rivers; (J. B. C.) Rocky River; (R. S. R.) Western River.

19. HYDROCHARITACEAE.

Ottelia ovalifolia, (R. Br.) L. C. Rich.—(R. T.) Cygnet River; (J. B. C.) Lower Cygnet River, Rocky River.

?x*Vallisneria spiralis,* L.—(J. B. C.) Lower Cygnet River (not in flower).

Halophila ovalis, (R. Br.) Hook f.—(R. T.) Bay of Shoals, Nepean River; (J. B. C.) Kingscote.

20. GRAMINEAE.

[x?*Themeda triandra,* Forsk.—(J. B. C.) K.I. ? requires confirmation.]

†*Neurachne alopecuroides,* R. Br.—(J. B. C.) Between Kingscote and Vivonne Bay (Nov.).

Spinifex hirsutus, Labill.—(R. T.) Bay of Shoals, Nepean Bay, D'Estrees Bay, etc., American Beach; (J. H. M.) Hog Bay; (J. B. C.) Bay of Shoals, Beatrice Island.

Microlaena stipoides, (Labill.) R. Br.—(R. T. as *Ehrharta stipoides)* Cygnet River, shady places throughout Dudley Peninsula; (Tepper as *Aristida Behriana,* F. v. M., *teste* Tate) Karatta; (J. B. C.) Rocky River.

**Phalaris minor,* Retz.—(R. T.) Dudley Peninsula; (J. B. C.) K.I.

**Ph. canariensis,* L.—(R. T.) Dudley Peninsula.

**Ph. paradoxa,* L.—Kingscote in Black's Flora.

†*Stipa elegantissima,* Labill.—(J. B. C.) Kingscote.

S. teretifolia, Steud.—(R. T.) Rocks by the sea, north coast of Dudley Peninsula; (J. B. C.) Near the sea, Hog Bay, Bay of Shoals, Pennington Bay.

†*S. eremophila,* Reader.—(J. B. C.) Kingscote (Nov.).

S. pubescens, R. Br.—(R. T. as *S. aristiglumis)* American River, Discovery Flat, throughout Dudley Peninsula.

S. semibarbata, R. Br.—(R. T.) Between American River and D'Estrees Bay; (J. H. M.) Cape Borda (coll. R. S. Rogers); (J. B. C.) near Vivonne Bay.

S. McAlpinei, Reader.—(J. B. C.) "One Year Grass," on recently burnt soil, Rocky River (Nov.).

†*S. variabilis,* Hughes.—(J. B. C.) Between Kingscote and Vivonne Bay.

Echinopogon ovatus, (Forst.) Beauv.—(R. T.) Cygnet and Hog Bay Rivers.

Sporobolus virginicus, (L.) Kunth.—(R. T.) Cygnet and Eleanor Rivers, north and north-west coasts of Dudley Peninsula, Hog Bay River, De Mole River; (J. B. C.) Vivonne Bay (March).

*x*Polypogon monspeliensis,* Desf.—(J. B. C.) Besides streams, Cygnet River, between Kingscote and Vivonne Bay.

Calamagrostis filiformis, (Forst.) Pilger.—(R. T. as *Agrostis solandri)* Towards Freestone Range, Nepean Bay, American River, Cygnet River, Dudley Peninsula; (J. B. C.) Rocky River.

†*C. filiformis,* var. *Billardieri,* Maid. et Betche.—(J. B. C.) Cape du Couëdic, near the sea.

C. quadriseta, (Labill.) Spreng.—(R. T. as *Agrostis quadriseta)* Cygnet and Stun' Sail Boom Rivers; (J. B. C.) Rocky River (Nov.).

†*C. minor,* Benth, (J. M. Black).—(J. B. C.) Rocky River (Nov.).

Dichelachne crinita, (L. f.) Hook. f.—(R. T.) North of Dudley Peninsula, Rocky Point, Hog Bay River.

D. sciurea, (R. Br.) Hook. f.—(R. T.) Heath near American River, throughout Dudley Peninsula; (J. B. C.) Rocky River.

**Lagurus ovatus*, L.—(Tepper) Queenscliff; (R. T.) Roll's Point, Telegraph Reserve, Eleanor River; (J. H. M.) Kingscote, well acclimatised; (J. B. C.) widespread, Bay of Shoals.

*†*Aira caryophyllea*, L.—(J. B. C.) K.I.

**Avena fatua*, L.—(R. T.) Dudley Peninsula.

Amphibromus nervosus, (R. Br.) Hook. f.—(R. T. as *Danthonia nervosa*) Cygnet and American Rivers.

†*Danthonia carphoides*, F. v. M.—(J. B. C.) Rocky River.

D. penicillata, (Labill.) F. v. M.—(R. T.) American River, Eleanor and Cygnet Rivers, throughout Dudley Peninsula; (J. H. M. as var. *setacea*) Kingscote; (J. B. C.) Rocky River, Kingscote.

**Briza maxima*, L.—(J. B. C.) K.I.

**B. minor*, L.—(R. T.) Dudley Peninsula; (J. B. C.) K.I.

*x*Dactylis glomerata*, L.—(J. B. C.) K.I.

Distichlis spicata, (L.) Greene.—(R. T. as *D. maritima*) K.I. (Heuzenroeder), Bay of Shoals, Nepean Bay, north coast of Dudley Peninsula; (J. B. C.) Vivonne Bay.

Poa caespitosa, Forst.—(R. T.) Sea cliffs along south coast, Bay of Shoals, throughout Dudley Peninsula; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) between Kingscote and Rocky River, Cape du Couëdic (Nov.).

P. caespitosa, var. *Billardieri*, Hook. f.—Sea coast of K.I. in Black's Flora; (J. B. C.) Cape du Couëdic (Nov.).

**P. annua*, L.—(R. T.) Dudley Peninsula.

P. lepida, F. v. M.—(Tepper) Cape Willoughby (coll. Horswill).

Glyceria stricta, Hook. f.—(Tepper as *Poa syrtica*, F. v. M.) Beach, Brownlow to Cygnet River.

Festuca littoralis, Labill.—(R. T.) Sand-dunes at Hog Bay River.

**F. bromoides*, L.—(R. T.) Freestone Hill Range and throughout Dudley Peninsula.

**F. elatior*, L., var. *arundinacea*, Hack.—Tate records *F. elatior (?)* for Dudley Peninsula.

**F. rigida*, (L.) Kunth.—(R. T.) Dudley Peninsula.

Bromus arenarius, Labill.—(R. T.) Sand-dunes at Hog Bay and American Beach.

**B. hordeaceus*, L.—(R. T. as *B. mollis*) Dudley Peninsula; (J. B. C.) K.I.

**B. maximus*, Desf.—(R. T. as *B. sterilis*) Dudley Peninsula.

**Lolium temulentum*, L.—(R. T.) Dudley Peninsula.

**L. perenne*, L.—(R. T.) Dudley Peninsula.

S. sculptus, Boech.—(R. T.) By runnels, heathy ground, Central Dudley Peninsula; (J. B. C.) Bay of Shoals.

Agropyrum scabrum, (Labill.) Beauv.—(R. T.) Towards Freestone Hill, American River, throughout Dudley Peninsula.

**Hordeum murinum*, L.—(R. T.) Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) Kingscote, Beatrice Island.

21. Cyperaceae.

x*Cyperus vaginatus*, R. Br.—(J. B. C.) Middle River.

Schoenus apogon, Roem et Sch.—(R. T.) Central Dudley Peninsula; (J. B. C.) Rocky River.

S. sculptus, Boech.—(R. T.) By runnels, heathy ground, Central Dudley Peninsula.

S. nitens, (R. Br.) Poir.—K.I., in Black's Flora.

S. Tepperi, F. v. M.—(R. T.) De Mole River, near D'Estrees Bay, White Lagoon, frequent in open heath land to beyond the Eleanor River.

S. discifer, Tate.—(R. T.) Central Dudley Peninsula.

x*S. brevifolius*, R. Br. ?—(J. B. C.) 20 miles east of Cape Borda.

S. fluitans, Hook. f.—(Tepper) Head of South-western River; (J. B. C.) Breakneck River.

Heleocharis sphacelata, R. Br.—(R. T.) Cygnet, Harriet, and Stun' Sail Boom Rivers; (J. B. C.) Cygnet River, Squashy Creek 27 miles east of Cape Borda, between Vivonne Bay and Rocky River, Rocky River.

H. acuta, R. Br.—(R. T.) Cygnet River at the "Sheep-wash."

H. multicaulis, Sm.—(R. T.) Stun' Sail Boom River; (J. B. C.) Squashy Creek 27 miles east of Cape Borda.

Scirpus fluitans, L.—(R. T.) Cygnet, Stun' Sail Boom, and Hog Bay Rivers; (J. B. C.) Tin Hut (on telegraph line to Cape Borda); (T. G. B. O.) Harriet River.

S. setaceus, L.—(R. T.) Central Dudley Peninsula.

S. cernuus, Vahl.—(R. T. as *S. riparius)* Eleanor River, Hog Bay (soakage at Frenchman's Rock, Central Dudley Peninsula; (J. B. C.) Rocky River.

S. antarcticus, L.—(R. T. as *S. cartilagineus)* North Dudley Peninsula, American River; (J. B. C.) Rocky River.

S. inundatus, (R. Br.) Poir.—(R. T.) Cygnet and Stun' Sail Boom Rivers; (J. B. C.) Rocky River, Squashy Creek and Tin Hut (27 and 35 miles respectively from Cape Borda).

S. nodosus, Rotth.—(R. T.) Nepean Bay, American River, Vivonne Bay, American Beach, Hog Bay River; (J. B. C.) between Vivonne Bay and Rocky River, etc.

Chorizandra enodis, Nees.—(R. T.) Discovery Flat, Birchmore's Lagoon, White Lagoon; (J. B. C.) near Cygnet River; (T. G. B. O.) Harriet River.

Cladium junceum, R. Br.—(R. T.) Between Eleanor and Stun' Sail Boom Rivers; (J. B. C.) Rocky River, Tin Hut (35 miles east of Cape Borda).

†*C. Gunnii*, Hook. f.—(J. B. C.) Squashy Creek (27 miles east of Cape Borda). In Black's Flora it is stated that Bentham recorded this species for the Mount Lofty Range, "but it does not appear to have been found since."

†*C. arcuatum*, J. M. Black.—A new species; (J. B. C.) Rocky River.

C. capillaceum, (Benth.) C. B. Clarke.—(Tepper as *Schoenus capillaris*, F. v. M.)—Head of South-western River; (J. B. C.) Tin Hut (on telegraph line to Cape Borda).

C. filum (Labill.) R. Br.—(R. T.) De Mole River, White Lagoon, Hawk's Nest, Mount Pleasant near Karatta.

C. tetragonum, (Labill.) J. M. Black.—Tepper as *C. tetraquetrum)* Head of South western River; (J. B. C.) Squashy Creek (27 miles east of Cape Borda).

C. acutum, (Labill.) Poir.—(Tepper as *C. schoenoides)* Cape Borda, Limestone Hills; (R. T. as *C. schoenoides)* De Mole River.

Gahnia trifida, Labill.—K.I. in Black's Flora; (J. B. C.) Tin Hut (35 miles east of Cape Borda). Perhaps some of Tate's records of *Cladium filum* refer to this species.

G. deusta, (R. Br.) Benth.—(R. T. as *Cladium deustum)* Coast cliffs between Pennington Bay and Hog Bay River, stony ground between Mount Pleasant and Eleanor River; (J. B. C.) in sandy soil near Cape du Couëdic.

†*G. psittacorum*, Labill.— (J. B. C.) Tin Hut and other creeks along the telegraph line to Cape Borda.

†*G. hystrix*, J. M. Black.—A new species; (J. B. C.) Cape du Couëdic (Nov.).

Caustis pentandra, R. Br.—(R. T.) De Mole River, between American River and D'Estrees Bay, near White Lagoon, Karatta; (J. B. C.) near Vivonne Bay, between Vivonne Bay and Rocky River, telegraph line 20 miles east of Cape Borda; (R. S. R.) South-western River.

x*Lepidosperma exaltatum,* R. Br.—(J. B. C.) Rocky River, Breakneck River.

L. gladiatum, Labill.—(R. T.) Between Hog Bay River and False Cape; (J. B. C.) Pennington Bay.

x*L. concavum,* R. Br.—(J. B. C.) Vivonne Bay.

L. lineare, R. Br.—(Tepper) Hundred of Haines and elsewhere, larger than on the mainland as at Clarendon.

L. viscidum, R. Br.—(R. T.) Throughout the main mass of the Island; (J. B. C.) between Kingscote and Vivonne Bay.

L. canescens, Boeck.—K.I. in Black's Flora; (J. B. C.) Kingscote, Vivonne Bay road.

x*L. semiteres,* F. v. M.—(J. B. C.) Tin Hut on Cape Borda telegraph line, near Vivonne Bay.

L. carphoides, F. v. M.—(Tepper) Mount Pleasant; (J. B. C.) between Kingscote and Vivonne Bay.

L. filiforme is given by Tate as common for Dudley Peninsula, also for De Mole River, but there are no specimens in the Tate Herbarium, and none have been found since.

Carex appressa, R. Br.—(R. T. as *C. paniculata)* De Mole River; (Tepper as *C. paniculata)* Ravine des Casoars; (J. B. C.) banks of Rocky River, creek along Cape Borda telegraph line.

C. tereticaulis, F. v. M.—(R. T.) Stun' Sail Boom River.

C. pseudocyperus, L.—(R. T.) Stun' Sail Boom River.

22. LEMNACEAE.

Lemna trisulca, L.—(Tepper) Karatta.

L. minor, L.—(Tepper) K.I.

23. RESTIONACEAE.

Leptocarpus tenax, R. Br.—(Tepper) Karatta, Birchmore's Lagoon.

Hypolaena fastigiata, R. Br.—(R. T. as *Calostrophus fastigiatus)* De Mole River, between American River and D'Estrees Bay, White Lagoon, near Karatta; (J. B. C.) Rocky River (Nov.).

Lepyrodia sp.—(Tepper) Grassy Creek.

24. CENTROLEPIDACEAE.

Trithuria submersa, Hook. f.—(R. T.) By runnels, heath ground, Central Dudley Peninsula.

Brizula gracilis, (Sond.) Hieron.—(R. T. as *Aphelia gracilis)* By runnels, Central Dudley Peninsula; (J. B. C.) Rocky River.

B. pumilio, (F. v. M.) Hieron.—(R. T. as *Aphelia pumilio)* Mossy banks in gullies, and cliffs by the sea, north Dudley Peninsula.

Centrolepis polygyna, (R. Br.) Hieron.—(R. T.) With the last, North Dudley Peninsula; (J. B. C.) Rocky River (Nov.).

C. aristata, (R. Br.) Roem. et Schult.—(R. T.) De Mole River, Central Dudley Peninsula; var. *pygmaea,* sea slopes south of Kangaroo Head; (J. B. C.) Rocky River (Nov.).

x*C. fascicularis,* Labill.—(J. B. C.) Rocky River (Nov.), creek near Ravine des Casoars, Tin Hut (35 miles east of Cape Borda).

C. strigosa, (R. Br.) Roem. et Schult.—(R. T.) De Mole River, North Dudley Peninsula, American River; (J. B. C.) Rocky River (Nov.).

28. JUNCACEAE.

Juncus bufonius, L.—(R. T.) American River, Dudley Peninsula; (J. B. C.) Rocky River.

x*J. planifolius*, R. Br.—(J. B. C.) Squashy Creek (27 miles east of Cape Borda), Rocky River.

J. caespiticius, E. Mey.—(Tepper) Ravine des Casoars.

J. maritimus, Lamk., var. *australiensis*, Benth.—(Tepper as the type) Karatta; (J. B. C.) widespread.

J. pallidus, R. Br.—(R. T.) Common throughout the Island, De Mole River; (J. B. C.) widespread.

†*J. polyanthemus*, Buch. —(J. B. C.) Tin Hut (35 miles east of Cape Borda).

†*J. pauciflorus*, R. Br.—(J. B. C.) Rocky River.

Luzula campestris, DC.—(R. T.) Throughout Dudley Peninsula.

29. LILIACEAE.

Dianella revoluta, R. Br.—(J. H. M.) Kingscote, Hog Bay; (J. B. C.) between Vivonne Bay and Rocky River, etc.

D. laevis, R. Br.—(R. T.) Cygnet River, Western Cove, towards D'Estrees Bay, Karatta, Dudley Peninsula; (R. S. R.) Kingscote (Sept.).

Burchardia umbellata, R. Br.—(R. T.) Near D'Estrees Bay, Central Dudley Peninsula, Hog Bay River; (J. B. C.) Breakneck River (Nov.); (R. S. R.) Kingscote (Sept.).

Anguillaria dioica, R. Br.—(Tepper) Karatta; (R. S. R.) near Cape Borda (Sept.), Ravine des Casoars.

Thysanotus Patersonii, R. Br.—(R. T.) De Mole River; (R. S. R.) Harvey's Return (Oct.).

Th. tuberosus, R. Br.—(Tepper) Karatta.

Th. dichotomus, (Labill.) R. Br.—(J. H. M.) Hog Bay; (J. B. C.) between Kingscote and Vivonne Bay (Nov.); telegraph line to Cape Borda (Feb.).

Chamaescilla corymbosa, (R. Br.) F. v. M.—(J. B. C.) K.I.

Tricoryne elatior, R. Br.—(Tepper) Mount Taylor.

Bulbine semibarbata, (R. Br.) Haw.—(R. T.) De Mole River; (J. H. M.) Hog Bay; (R. S. R.) Middle River (Oct.); (J. B. C.) between Kingscote and Vivonne Bay.

Dichopogon strictus, (R. Br.) J. G. Bak.—(R. T. as *Arthropodium strictum)* North-west parts of Dudley Peninsula, gorge of Hog Bay River.

D. fimbriatus, (R. Br.) J. M. Black.—In Tate's list as *Arthropodium laxum*, Kingscote Point.

Bartlingia sessilflora, (Dene) F. v. M.—(Tepper) Karatta; (J. B. C.) K.I.; (T. G. B. O.) Harriet River.

Xanthorrhoea quadrangulata, F. v M.—(R. T., probably *X. Tateana* is meant) South side of Cygnet River to D'Estrees Bay and Stun' Sail Boom River, Central Dudley Peninsula; (J. H. M.) Hog Bay.

X. Tateana, F. v. M.—(R. T. as *X. Tatei)* De Mole River; (J. B. C.) Rocky River, Vivonne Bay, etc.

IRIDACEAE.

Patersonia glauca, R. Br.—(R. T.) White Lagoon, near Karatta, De Mole River; (J. B. C.) Rocky River (Nov.).

Orthrosanthus multiflorus, Sweet.—(R. T. as *Sisyrinchium cyaneum)* K.I. (R. Brown), widely distributed throughout Dudley Peninsula, common on the north coast and extending to Karatta, occasionally at Mount Mary and American Beach; (J. H. M.) Hog Bay; (R. S. R.) Kingscote (Sept.), Harvey's Return (Sept.); (J. B. C.) Kingscote (Nov.), Rocky River, Cape Borda.

ORCHIDACEAE.

x*Gastrodia sesamoides*, R. Br. -(R. S. R.) Flinders Chase (Prof. Wood Jones), Oct.

Calochilus Robertsonii, Benth.—Middle and Western Rivers, Cape Borda (Nov.).

x*Thelymitra ixioides,* Sw.—(R. S. R.), Cape Borda (Oct).

T. luteociliata, Fitzg.—Kingscote, Birchmore Lagoon, a swamp form, blooms September.

T. grandiflora, Fitzg.—Ironstone Hill, near Western River. Numerous in this locality, with exceptionally large leaves. In bud at end of September. Bloomed early in October when transplanted to Adelaide.

T. aristata, Lindl.—Hog Bay River (South Coast). September and October.

T. longifolia, Forst.—Dudley Peninsula. October and November.

T. pauciflora, R. Br.—Kingscote, Ravine des Casoars Creek. September.

T. fusco-lutea, R. Br.—Ironstone Hill, near Western River, Cape Borda (Nov.); (T. G. B. O.) Flinders Chase and between Kingscote and Vivonne Bay (ironstone tablelands).

T. carnea, R. Br.—Stun' Sail Boom River. October.

T. flexuosa, Endl.—Widely distributed on the tableland between Ravine Creek and Tin Hut. October.

T. antennifera, Hook. f.—Widely distributed; Stokes' Bay, Stun' Sail Boom River, Western River, S.W. River, Harriet River, Timber Creek, Dudley Peninsula. September and October.

Microtis porrifolia, R. Br.—Dudley Peninsula, Kingscote, Cygnet River, Salt Creek, Stokes' Bay, Western River. October and November.

x*M. parviflora,* R. Br.—(R. S. R.) Vivonne Bay. November.

Prasophyllum australe, R. Br.—(R. S. R.) Harriet River. December and January.

P. elatum, R. Br.—Snug Cove, Harvey's Return, Cape Borda, Dudley Peninsula. Almost black in colour. Locally known as the "Blackboy." I have not so far met the lighter-coloured forms which are found on the mainland. October and November. (T. G. B. O.) Flinders Chase, near Rocky River. October.

P. patens, R. Br.—Kingscote, Dudley Peninsula. October.

P. fuscum, R. Br.—Retta's Lagoon, Kingscote. October.

P. nigricans, R. Br.—It seemed probable that the smaller species of *Prasophyllum* would be represented on the Island, especially as one of these occurs on Yorke Peninsula. I was fortunate enough to find a single late bloom in May when on a visit to Harcus Camp, on the tableland south-west of the Kohinoor Mine. It was not the Peninsula species, however, but one much more widely distributed. Later we found it in seed at Kingscote in September.

Corysanthes pruinosa, A. Cunn.—Swamp near Harvey's Return (Mrs. R. S. Rogers). July and August. Late bloom in September.

Acianthus caudatus, R. Br.—De Mole River. September.

A. exsertus, R. Br.—Hog Bay River, Kingscote, Harvey's Return. May, June, and July.

Cyrtostylis reniformis, R. Br.—Dudley Peninsula, Harvey's Return, Ravine des Casoars Creek. July to September.

Lyperanthus nigricans, R. Br.—Hog Bay River, Stokes' Bay, Harriet River, Eleanor River, Mount Pleasant, Retta Lagoon, and Cygnet River. September and October.

Eriochilus autumnalis, R. Br.—I have found this species at Harcus Camp in seed in May; probably it has a much wider distribution, but has not been recorded owing to its early time of blooming.

Leptoceras fimbriata, Lindl.—Leaves fairly numerous at Stokes' Bay and Rocky River. Should be looked for in May and June.

Caladenia cardiochila, Tate.—Kingscote.

C. ovata, Rogers.—I have not seen this species on the North Coast, but have found it in considerable numbers on the South Coast about Wilson River and the Eleanor. I have never met it on the mainland. It blooms in September and October.

C. reticulata, Fitzg.—Cygnet River, Mount Pleasant, Eleanor River. September.

C. Patersonii, R. Br.—This species has so long been considered a legitimate dumping-ground for divergent forms, that perhaps no apology is required for placing still another under this heading. The Kangaroo Island form may conveniently be placed here for the present, although it seems to me a very distinct type. So far, I have been unable to discover the presence on the Island of the forms which are so prevalent on the contiguous mainland, *e.g.*, Yorke Peninsula. As in the case of *C. filamentosa*, the only place in the State in which I have known the Kangaroo Island form of *C. Patersonii* to occur is Monarto, where I have collected it at about the same time of the year. It has a narrow leaf, varying from linear-lanceolate to oblong-lanceolate. The flower is usually solitary, the general colouring being yellow with red markings. The latter are shown by a red line running down the middle of each perianth segment, by the strongly-marked red clavate points of each sepal, and by the red tip of the labellum. There are four rows of calli, and the margins of the labellum are denticulated, though not deeply so. The caudae are comparatively short, and not hairy, as in the typical forms of *C. Patersonii*. Next to *C. filamentosa* this is the most prevalent "spider" west of Kingscote.

C. dilatata, R. Br.—Dudley Peninsula, Kingscote, Ravine des Casoars. September and October.

C. filamentosa, R. Br.—This beautiful dark crimson form is widely distributed throughout the Island. I know only one locality on the mainland where it is to be found, *viz.*, Monarto, near Murray Bridge. It has struck me as an interesting fact that *C. tentaculata*, a closely allied light-coloured species, so common around the northern and western sides of the Gulf, does not occur on the Island. I have found both forms at Monarto. September and October.

C. bicalliata, Rogers. A single specimen of this dainty little orchid was found by Mrs. R. S. Rogers near Kingscote on September 20, 1908. It was growing in rather sandy soil near the roadside on the margin of the scrub.

C. Menziesii, R. Br.—Stokes' Bay, Cape Borda, Ravine des Casoars, Harvey's Return. September and October. (T. G. B. O.) Flinders Chase, near Rocky River.

C. latifolia, R. Br.—Kingscote, Harvey's Return, Ravine des Casoars Creek, and very common on Dudley Peninsula. September.

C. carnea, R. Br.—Not common, but widely distributed. I have found it on Dudley Peninsula, Kingscote, Rocky River, vicinity of Cape du Couëdic, South-west River, Harriet River. September.

x*C. caerulea*, R. Br.—(R. S. R.) Flinders Chase (Prof. F. Wood Jones). September.

C. deformis, R. Br.—This probably shares the place of honour with *Diuris longifolia* in being the most common orchid on the Island, some parts being literally converted into blue carpets in September, when it is at its best. It became scarcer as we skirted the Western Coast, but is represented everywhere.

Diuris longifolia, R. Br.—This orchid is extraordinarily prolific and is to be found in vast quantities from one end of the Island to the other. September and October.

D. brevifolia, Rogers.—(R. S. R.) Flinders Chase. November.

x*D. sulphurea*, R. Br.—(R. S. R.) Harriet River. December.

P. nutans, R. Br.—Ravine des Casoars Reserve, Cape Borda. A few good blooms last week in September.

Pterostylis nana, R. Br.—Widely distributed throughout the Island. August and September.

x*P. pedunculata*, R. Br.—(R. S. R.) Harvey's Return, Cape Borda. August.

P. furcata, Lindl.—Late blooms found in January near Karatta on Stun' Sail Boom River. I described this orchid as a species new to the State in Trans. Roy. Soc. S. Austr., 1907, vol. xxxi., p. 125, pl. xxii.

P. reflexa, R. Br. Harvey's Return (Mrs. R. S. Rogers). June, July, and August.

P. alata, (Labill.) Reichb. f.—(R. S. R.) Dudley Peninsula, Ravine Creek. May, June, and July.

P. obtusa, R. Br.—Ravine Creek, near Cape Borda, in moist shady ground. Half a dozen withered specimens found end of September, 1908 (Mrs. R. S. Rogers). Blooms probably July and August. This species has only been previously recorded from the Port Victor district.

P. barbata, Lindl.—Hog Bay River, S.W. River, Harriet River, Eleanor River. September and October.

P. longifolia, R. Br.—This plant bears rather a striking contrast to our mainland form, the flowers being much smaller (galea 1 cm., or even less) and the habit exceedingly slender. The height varies from about 10-30 cm. Late blooms found at Kingscote in September.

P. vittata, Lindl.—Widely distributed throughout the Island. June and August.

33. Casuarinaceae.

Casuarina stricta, Ait.—(R. T. as *C. quadrivalvis*) Salt Lagoon, Kingscote Point, Western Cove, American River, north coast of Dudley Peninsula, Hog Bay River; (J. B. C.) Vivonne Bay, Harvey's Return.

?*C. Muelleriana*, Miq.—(R. T. This and the next species are included under *C. distyla*) Cygnet River to D'Estrees Bay, and Stun' Sail Boom River, Central Dudley Peninsula; (J. B. C.) between Kingscote and Vivonne Bay.

C. sp. (J. B. C.) Between Kingscote and Vivonne Bay.

35. Urticaceae.

Parietaria debilis, G. Forst.—(R. T.) K.I. (in Fl. Austr.), throughout Dudley Peninsula; (T. G. B. O.) Harriet River. October.

**Urtica urens*, L.—(R. T.) Dudley Peninsula; (J. B. C. probably) Rocky River; (R. S. R.) near Cape Borda.

U. incisa, Poir.—(R. T.) Lower Cygnet River; (J. B. C.) Ravine des Casoars.

36. Proteaceae.

Petrophila multisecta, F. v. M.—(R. T.) K.I. (Waterhouse), Cygnet River, eastward to American River, and south-west to Stun' Sail Boom River, De Mole River; (J. B. C.) between Kingscote and Vivonne Bay, Rocky River.

Isopogon ceratophyllus, R. Br.—(R. T.) De Mole River; (J. B. C.) Rocky River, Cape Borda; (R. S. R.) Ravine des Casoars (Oct., 1908).

Adenanthos sericea, Labill., var. *brevifolia*, Benth.—(R. T. as *A. sericea*) K.I. (Waterhouse), Cygnet River to Red Banks, American River, and D'Estrees Bay, thence to Eleanor River, etc., De Mole River; (J. B. C., flowers pinky-red, not yellow as in the generic description in Black's Flora) 20 miles east of Rocky River; (R. S. R.) Kingscote (Sept., 1908), near Cape Borda (Sept., 1908), Cape du Couëdic (Oct., 1908), Stokes' Bay to Western River.

A. terminalis, R. Br.—(R. T.) De Mole River; (J. B. C.) between Vivonne Bay and Rocky River.

Conospermum patens, Schlechtd.—(R. T.) K.I. (Waterhouse), near D'Estrees Bay, north of Mount Pleasant, near Karatta, De Mole River; (J. B. C.) Kingscote, Vivonne Bay road, Rocky River, near Cape Borda; (R. S. R.) Western River.

x*Hakea vittata*, R. Br.—(J. B. C.) Vivonne Bay.

H. rostrata, F. v. M.—(R. T.) American River and along the South Coast, Central Dudley Peninsula, De Mole River; (J. B. C.) Kingscote, Vivonne Bay road, Cape Borda, Harvey's Return.

H. rugosa, R. Br.—(R. T.) K.I. (Waterhouse), American River to D'Estrees Bay, South Coast of Central Dudley Peninsula (coll. R. S. Rogers); (J. B. C.) K.I.; (T. B. G. O.) Flinders Chase, Rocky River, and Breakneck Creek (Nov.).

H. ulicina, R. Br.—(J. B. C.) Vivonne Bay, Rocky River, Cape Borda.

H. ulicina, var. *flexilis*, F. v. M.—(R. T. as *H. flexilis*) K.I. (Waterhouse), west of Bay of Shoals, south of Cygnet River to Birchmore Lagoon, Murray Lagoon, and thence to Karatta; (J. B. C.) Rocky River, Cape Borda. Tepper records *H. ulicina*, var. *carinata*, for Cape Borda.

x*H.*, near *H. multilineata*, Meisn.—(J. B. C.) Several small plants, showing no signs of flowering, on heathy ground 4 or 5 miles north of Rocky River Homestead, leaves differing (Prof. Osborn and Miss Macklin) microscopically from those of S.A. specimens of *H. multilineata*.

Banksia marginata, Cav.—(R. T.) K.I. (Waterhouse), Cygnet River to D'Estrees Bay and Stun' Sail Boom River, De Mole River; (R. S. R.) Rocky River; (J. B. C.) near Harvey's Return.

B. ornata, F. v. M.—(R. T.) K.I. (*Frag. Phyt.*), Cygnet River, and Birchmore Lagoon, between American River and D'Estrees Bay, White Lagoon, and frequently to Stun' Sail Boom River, De Mole River; (J. B. C.) near Cape Borda, etc.

Grevillea ilicifolia, R. Br.—(R. T.) K.I. (Waterhouse), Kingscote, south of Cygnet River, American River, White's Lagoon to Eleanor River; (J. B. C.) between Kingscote and Vivonne Bay (flowers greenish), Vivonne Bay, Rocky River; (R. S. R.) Stokes' Bay to Western River (Oct., 1908).

G. parviflora, R. Br.—(R. T. as var. ?) K.I. (Waterhouse), Stun' Sail Boom River at Karatta; K.I. (Black's Flora).

G. parviflora, var. *acuaria*, F. v. M.—(R. T., as above, probably in part) K.I. (Black's Flora); (J. B. C.) Rocky River; (T. G. B. O.) in dense scrub, Flinders Chase (Oct., 1924).

G. pauciflora, R. Br.—(Tepper) Head of the S.W. River; (R. S. R.) S.W. River, Cape du Couëdic (Oct., 1908), near Karatta, Ravine des Casoars; (J. B. C.) between Cape du Couëdic and Rocky River, near Cape Borda.

G. quinquenervis, J. M. Black.—Snug Cove and near Cape Borda (Black's Flora); (J. B. C.) Rocky River, near Cape Borda.

G. aspera, R. Br.—(R. T.) De Mole River.

G. lavandulacea, R. Br.—(R. T.) De Mole River.

G. Rogersii, Maiden.—(R. S. R.) Harvey's Return (Oct., 1907), Ravine des Casoars; (J. B.C.) Harvey's Return, Kingscote-Vivonne Bay road.

37. Santalaceae.

Exocarpus cupressiformis, Labill.—(R. T.) K.I. (Waterhouse), Stun' Sail Boom River, throughout Dudley Peninsula; (J. B. C.) Cygnet River, between Vivonne Bay and Rocky River.

Leptomeria aphylla, R. Br.—(R. T.) Near the Eleanor River, Karatta; (J. B. C.) Rocky River.

Choretrum glomeratum, R. Br.—(R. T.) Bay of Shoals, Kingscote to D'Estrees Bay and Stun' Sail Boom River, Central Dudley Peninsula, De Mole River; (J. H. M.) Kingscote; (J. B. C.) Bay of Shoals, Harvey's Return; (T. G. B. O.) Flinders Chase.

Ch. spicatum, F. v. M.—(R. T.) K.I. (Bannier); (J. B. C.) Rocky River, Cape Borda, near Harvey's Return.

Fusanus acuminatus, R. Br.—In Tate's Census for K.I.

F. persicarius, F. v. M.—(Tepper) Cape Willoughby (coll. Horswill).

38. Olacaceae.

Olax Benthamiana, Miq.—(Tepper) Scrub land near Cape Borda; (J. H. M.) Cape Borda (coll. R. S. Rogers); (J. B. C.) near Cape Borda.

40. Polygonaceae.

Rumex Brownii, Campd.—(R. T.) K.I. (Heuzenroeder), Cygnet River, throughout Dudley Peninsula; (J. B. C.) Rocky River.

*x*R. crispus*, L.—(J. B. C.) Kingscote, Middle River.

*x*R. Acetosella*, L.—(J. B. C.) Rocky River.

**Polygonum aviculare*, L.—(R. T.) Dudley Peninsula; (J. B. C.) Rocky River.

Muehlenbeckia adpressa, (Labill.) Meisn.—(R. T.) K.I. (Waterhouse), bushy places and heath ground, especially near the sea, mallee scrub and thickets throughout Dudley Peninsula; (J. H. M.) Hog Bay, Cape Borda (coll. R. S. Rogers); (J. B. C.) Ravine des Casoars, etc.; (T. G. B. O.) Rocky River.

41. Chenopodiaceae.

†*Rhagodia baccata*, (Labill.) Moq.—(J. B. C.) Vivonne Bay, Pennington Bay, Kingscote.

Rh. crassifolia, R. Br.—(R. T.) K.I. (R. Brown), seacliffs and salt swamps from American River to Bay of Shoals, North and West Dudley Peninsula; (J. B. C.) Kingscote, Vivonne Bay, American River; (T. G. B. O.) Cape du Couëdic (Nov., 1923).

Rh. nutans, R. Br.—(R. T.) K.I. (R. Brown), rocks by the sea on north coast of Dudley Peninsula and to American Beach; (J. B. C.) Bay of Shoals (?).

Chenopodium carinatum, R. Br.—(R. T.) K.I. (R. Brown as *Ch. pumilio*, R. Br., grassy slopes by the sea on north coast of Dudley Peninsula). (Probably a small form of the preceding.—J. M. B.)

*x*Ch. murale*, L.—(J. B. C.) Kingscote.

**Ch. glaucum*, L.—(R. T.) K.I., probably Cygnet River (Waterhouse), Dudley Peninsula; (Tepper as *Rhagodia parabolica*) (*teste* Tate), Kinch's, Cygnet River; (J. B. C.) mouth of Cygnet River, Bay of Shoals (?), Middle River.

Atriplex paludosum, R. Br.—(R. T.) K.I. (R. Brown, Waterhouse), Bay of Shoals, north coast of Dudley Peninsula to American River; mouth of Cygnet River, Beatrice Island.

A. cinereum, Poir.—(R. T.) K.I. (Waterhouse), Kingscote Point, Bay of Shoals, Hog Bay, American Beach; (J. B. C.) Kingscote, Vivonne Bay, Pennington Bay.

A. prostratum, R. Br.—(R. T.) K.I. (R. Brown).

Kochia oppositifolia, F. v. M.—(R. T.) Rocks by the sea between Penneshaw and Kangaroo Head; (J. B. C.) American River, mouth of Cygnet River, Bay of Shoals.

x*Salsola kali*, L.—(J. B. C.) Kingscote.

Suaeda australis, (R. Br.) Moq.—(R. T. as *S. maritima)* Rocks by the sea, north coast of Dudley Peninsula, sandhills at American Beach and Hog Bay.

Enchylaena tomentosa, R. Br.—(R. T.) Kingscote, Christmas Cove and American Beach, Dudley Peninsula; (J. B. C.) Kingscote (yellow fruits), Beatrice Island.

Threlkeldia diffusa, R. Br.—In Tate's Census for K.I.

†*Arthrocnemum halocnemoides*, Nees.—(J. B. C.) Near Kingscote.

A. arbuscula, (R. Br.) Moq.—(R. T. as *Salicornia arbuscula)* Nepean Bay, American River, Christmas Cove; (J. B. C.) American River (?).

Salicornia australis, Banks et Sol.—(R. T.) Common in salt swamps; (J. H. M.) Kingscote; (J. B. C.) American River, Eleanor River (?), forming low green patches left by the receding tide at Bay of Shoals; (T. G. B. O.) Cape du Couëdic (Nov., 1923).

42. Amarantaceae.

Hemichroa pentandra, R. Br.—(R. T. as *Polycnemon pentandrum)* Saline swamp at head of Bay of Shoals, east of Pelican Lagoon; (J. B. C.) Vivonne Bay (March), Bay of Shoals (probably).

Trichinium Beckerianum, F. v. M.—(R. T. as *Ptilotus Beckeri)* On ironstone gravel after fire, about Mount Pleasant, and hence to Eleanor River.

A. denticulata, R. Br.—(R. T. as *A. triandra)* Banks of Cygnet River.

44. Phytolaccaceae.

Didymotheca thesioides, Hook. f.—(R. T.) Hog Bay River to Rocky Point, American Beach; (J. B. C.) near Pennington Bay, between Kingscote and Vivonne Bay, Rocky River (Nov.).

Gyrostemon australasicus, (Moq.) Heimerl.—(R. T. as *Didymotheca pleiococca)* K.I. (Waterhouse), between American River and D'Estrees Bay, between White Lagoon and Hawk's Nest, towards the Eleanor and Stun' Sail Boom Rivers; (R. S. R.) Kingscote, Parrot Paddock; (J. B. C.) near Pennington Bay, between Kingscote and Vivonne Bay (Nov.).

45. Aizoaceae.

Mesembrianthemum aequilaterale, Haw.—(R. T.) Sand dunes, common; (J. H. M.) Hog Bay; (J. B. C.) Bay of Shoals, etc.

M. australe, Soland.—(R. T.) Bay of Shoals, Nepean Bay, north coast of Dudley Peninsula, De Mole River; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) K.I.

Tetragonia implexicoma, (Moq.) Hook. f.—(R. T.) D'Estrees Bay, north and west coasts of Dudley Peninsula; (J. B. C.) widely distributed near the coast.

46. PORTULACACEAE.

Calandrinia volubilis, Benth.—(R. T. as *Claytonia volubilis*) North coast of Dudley Peninsula.

C. calyptrata, Hook. f.—(R. T. as *Claytonia calyptrata*) Kangaroo Head, gorge of the Hog Bay River, De Mole River.

47. CARYOPHYLLACEAE.

Sagina procumbens, L.—K.I. in Black's Flora.

S. apetala, Ard.—(R. T.) Western Cove, Nepean Bay, throughout Dudley Peninsula, especially near the coast.

**Cerastium glomeratum*, Thuill.—(R. T. as *C. vulgatum*) Dudley Peninsula.

Stellaria palustris, Retz.—(R. T. as *S. glauca*) Christmas Cove, gullies of North Dudley Peninsula, Hog Bay River.

**S. media*, (L.) Vill.—(R. T.) Dudley Peninsula.

Spergularia rubra, (L.) J. et C. Presl.—(R. T.) North coast of Dudley Peninsula; (J. B. C.) Middle River (?).

S. marginata, (DC.) Kitt. (?).—(R. T. as *S. marina*) Saline swamps, Bay of Shoals, Nepean Bay, salt water creeks, North Dudley Peninsula.

**Silene gallica*, L.—(R. T.) Dudley Peninsula; (J. B. C.) K.I.

**Tunica prolifera*, (L.) Scop. (*Dianthus prolifer*, L.)—(J. B. C.) Kingscote, Rocky River.

49. RANUNCULACEAE.

Clematis microphylla, DC.—(R. T.) Common near the coast; (J. H. M.) Hog Bay; (J. B. C.) Kingscote.

†?*Ranunculus trichophyllus*, Chaix.—(J. B. C.) Leaves in water at Ravine des Casoars suggesting this species.

R. rivularis, Banks et Sol.—(Tepper) Ravine des Casoars; (R. T.) De Mole River; (J. B. C.) between Vivonne Bay and Rocky River; (T. G. B. O.) in peaty swamp, Rocky River (Oct., 1924).

R. parviflorus, L.—(R. T.) Near Kangaroo Head.

50. LAURACEAE.

Cassytha glabella, R. Br.—(R. T.) K.I. (Sealey), sandy heath ground, parsitic on *Lepidosperma filiforme* chiefly; (J. B. C.) widely distributed, Vivonne Bay, Rocky River, Cape Borda.

C. pubescens, R. Br.—(R. T.) Parasitic on small heathy shrubs and *Melaleuca uncinata*, De Mole River, etc.; (Tepper as *Cassytha* sp., *teste* Tate), Karatta; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) between Kingscote and Vivonne Bay, Vivonne Bay.

C. melantha, R. Br.—(R. T.) Parasitic on the smaller Eucalyptus chiefly; (J. B. C.) Bay of Shoals.

51. PAPAVERACEAE.

Papaver aculeatum, Thunb.—(R. T.) Sandhills at American Beach and rocky ground northward to Kangaroo Head, Kingscote, D'Estrees Bay.

**P. hybridum*, L.—(R. S. R.) Cape du Couëdic (Oct., 1908).

52. CRUCIFERAE.

**Sisymbrium officinale*, L.—(R. T.) Dudley Peninsula.

*x*Diplotaxis muralis*, (L.) DC.—(J. B. C.) Kingscote.

Lepidium foliosum, Desv.—(R. T.) K.I. (Bannier); (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) mouth of Cygnet River.

L. pseudo-ruderale, Thell.—(R. T. as *L. ruderale*) Dudley Peninsula, Flour Cask Bay, Eleanor River, Kingscote, Bay of Shoals.

**Capsella Bursa-pastoris*, (L.) Moench.—(R. T.) Dudley Peninsula.

Hutchinsia procumbens, (L.) Desv.—(R. T. as *Capsella procumbens* and in the Census as *C. elliptica*) North Dudley Peninsula, near Pelican Lagoon.

**Coronopus didymus*, (L.) Sm.—(R. T. as *Senebiera didyma)* Dudley Peninsula.

Cakile maritima, Scop.—(R. T.) D'Estrees Bay; (J. B. C.) Vivonne Bay, Pennington Bay, Middle River.

54. Resedaceae.

**Reseda alba*, L.—(J. H. M.) Kingscote.

55. Droseraceae.

x*Drosera binata*, Labill.—(J. B. C.) Breakneck River.

D. glanduligera, Lehm.—(Tepper) Karatta, near Kinch's Station; (R. S. R.) Middle River (Oct., 1908); (T. G. B. O.) Harriet River (Oct., 1922).

D. Whittakeri, Planch.—(R. T.) Dudley Peninsula (coll. R. S. Rogers), near D'Estrees Bay.

D. pygmaea, DC. (R. T.) Central Dudley Peninsula, De Mole River; (J. B. C.) Breakneck River, Squashy Creek (27 miles east of Cape Borda).

D. Planchonii, Hook. f.—(R. T. as *D. Menziesii)* Near D'Estrees Bay, near Kingscote (coll. R. S. Rogers); (R. S. R.) Harvey's Return (Oct., 1908), Middle River, Western River, Ravine des Casoars.

D. auriculata, Backh.—(R. T.) Central Dudley Peninsula, near D'Estrees Bay, Kingscote, De Mole River; (R. S. R.) Middle River (Oct., 1908); (J. B. C.) Rocky River.

D. peltata, Sm.—(R. S. R.) Middle River (Oct., 1908).

58. Crassulaceae.

Crassula Sieberiana, (Schult.) Ostenf.—(R. T. as *Tillaea verticillaris)* Dudley Peninsula, Bay of Shoals, Western Cove, De Mole River.

C. bonariensis, (DC.) Cambess. (as *Tillaea purpurata)*.—(R. S. R.) Cape du Couëdic (Oct., 1908).

C. recurva, (Hook. f.) Ostenf.—(R. T. as *Tillaea recurva)* Eleanor River.

C. macrantha, (Hook. f.) Diels et Pritzel.—(R. T. as *Tillaea macrantha)* Gullies of North Dudley Peninsula.

57. Saxifragaceae.

Bauera rubioides, Andr.—(Tepper) Grassy and other creeks and at the head of the S.W. River; (J. B. C.) Breakneck River, Squashy Creek (27 miles east of Cape Borda); (T. G. B. O.) in peaty swamp near Rocky River, October and November.

58. Pittosporaceae.

Pittosporum phillyreoides, DC.—(R. T.) K.I. (Waterhouse), east side of Bay of Shoals, about Salt Lagoon.

Bursaria spinosa, Cav.—(R. T.) Sandhills at Hog Bay, banks of Hog Bay, Cygnet, Harriet, and Stun' Sail Boom Rivers; (J. H. M.) Hog Bay; (J. B. C.) Cygnet River, Vivonne Bay, and Rocky River.

Marianthus bignoniaceus, F. v. M.—(R. T.) Thickets under the shade of sugar gum trees at Harriet and Stun' Sail Boom Rivers; (J. B. C.) Rocky River (Nov.).

Cheiranthera linearis, A. Cunn.—(R. T.) K.I. (Waterhouse).

Ch. volubilis, Benth.—(R. T.) Scrub in K.I. (Waterhouse); (J. B. C.) between Breakneck and Rocky Rivers (Nov.).

Billardiera cymosa, F. v. M.—(R. T.) K.I. (Waterhouse), throughout Dudley Peninsula, Kingscote, American River, Harriet and Stun' Sail Boom Rivers; (J. B. C.) between Kingscote and Vivonne Bay (Nov.).

B. scandens, Sm. (Tepper) West of Cape Willoughby, Karatta; (J. B. C.) between Kingscote and Vivonne Bay (Nov.); (T. G. B. O.) Rocky River, (Nov., 1922).

59. Rosaceae.

Rubus parvifolius, L.—(R. T.) Hog Bay River.

*x*R. fruticosus*, L. (Blackberry).—(J. B. C.) Middle River.

*x*Rosa rubiginosa*, L. (Sweetbriar).—(J. B. C.) Cygnet River.

**Alchemilla arvensis*, Scop.—(R. T.) Dudley Peninsula.

Acaena ovina, A. Cunn.—(R. T.) Pasture slopes by the sea, south of Kangaroo Head.

A. Sanguisorbae, (L. f.) Vahl.—(R. T.) K.I. (R. Brown), Dudley Peninsula, Kingscote, etc., Mount Pleasant to Stun' Sail Boom River; (J. H. M.) Hog Bay; (J. B. C.) Cygnet River.

60. Leguminosae.

Acacia armata, R. Br.—(R. T.) K.I. (R. Brown), common throughout the Island, forming dense thickets in the calciferous sand-rock formation; (J. B. C.) Kingscote, Bay of Shoals, Ravine des Casoars; (R. S. R.) Harvey's Return (Oct., 1908).

A. acinacea, Lindl.—Near Mount Thisbe (coll. H. Griffith).

A. microcarpa, F. v. M.—(R. T.) Between Rocky Point and Salt Lagoon, Dudley Peninsula; (J. B. C.) ? Vivonne Bay.

A. spinescens, Benth.—(R. T.) Central Dudley Peninsula; (R. S. R.) Harvey's Return, Ravine des Casoars (Oct., 1908).

A. dodonaeifolia, (Pers.) Willd.—(R. T.) K.I. (Baudin's Expedition); (R. S. R.) Middle River, Stokes' Bay, Western River (Oct., 1908).

A. brachybotrya, Benth.—(R. T.) Murray's Lagoon (*A. acinacea* (?) of Tepper's List, White's Lagoon, is, *teste* Tate, probably this species).

A. rhetinodes, Schl.—(R. T. as *A. retinodes*) K.I. (Waterhouse), thickets along watercourses in south-western parts, sandhills round Vivonne Bay and Hog Bay River, De Mole River; (J. B. C.) Rocky River, between Kingscote and Vivonne Bay, Ravine des Casoars; (R. S. R.) Ravine des Casoars.

A. ligulata, A. Cunn.—(Tepper as *A. salicina*, Lindl.) Karatta; (R. S. R. as *A. salicina*, var. *Wayae*, Maiden) K.I.; (J. B. C.) Bay of Shoals, Kingscote, Rocky River.

A. myrtifolia, (Sm.) Willd., and as var. *angustifolia*, Benth.—(R. T. as *A. myrtifolia* with note) De Mole River; (Tepper) between Grassy Creek and Ravine des Casoars; (J. B. C.) between Kingscote, Vivonne Bay, and Rocky River, widely distributed; (R. S. R.) Stokes' Bay, Western River (Oct., 1908), Mount Pleasant, Rocky River (all as *A. myrtifolia)*, Snug Cove (Oct., 1908), Sandy Creek, S.W. River (as var. *angustifolia)*.

A. pycnantha, Benth.—(R. T.) North Dudley Peninsula; (J. B. C.) Cygnet River, Rocky River; (R. S. R.) Rocky River.

A. notabilis, F. v. M.—(Tepper) Near Brownlow and elsewhere; (R. S. R., identified by J. H. Maiden) Stokes' Bay, Western River, (Oct., 1908), Mount Pleasant.

A. calamifolia, Sweet, var. *euthycarpa*, J. M. Black.—(R. T. *A. calamifolia* is presumably the variety) K.I. (Flora Austr.), Bay of Shoals, south of Cygnet River, White's Lagoon; (R. S. R. as *A. calamifolia)* Kingscote (Sept., 1908), Stokes' Bay, Western River (Oct., 1908).

A. rupicola, F. v. M.—(R. T.) Mount Mary, Karatta; (J. B. C.) Vivonne Bay.

A. farinosa, Lindl.—(R. T.) K.I. (Waterhouse); K.I. in Black's Flora; (R. S. R.) Harriet River, S.W. River, Western River, Middle River, Stokes' Bay (Oct., 1908); (Tepper) as *A. Whanii*, F. v. M., south west of Birchmore's Lagoon.

A. verticillata, (L'Hér.) Willd.—(R. T.) Near Karatta; (J. B. C.) Squashy Creek; (R. S. R.) De Mole River, Stokes' Bay (Oct., 1908), Mount Pleasant; (T. G. B. O.) Rocky River (Nov., 1923).

A. longifolia, (Andr.) Willd., var. *Sophorae,* F. v. M.—*A. brevifolia,* Tepper's List, Stun' Sail Boom River, is, *teste* Tate, probably *A. longifolia.* (Tepper) White Gum Valley, south of Hog Bay; (J. B. C.) between sandhills near the coast, Middle River, Vivonne Bay, Pennington Bay.

Gompholobium minus, Sm.—(R. T.) K.I. (Waterhouse), between American River and D'Estrees Bay, between Birchmore's Lagoon and Mount Pleasant, De Mole River; (J. B. C.) flowers salmon coloured, sometimes yellow (on mainland usually yellow), Kingscote, Vivonne Bay, Rocky River road, Rocky River.

Viminaria denudata, Sm.—(J. B. C.) Breakneck River.

Daviesia corymbosa, Sm.—(Tepper as var. *mimosoides,* R. Br.) Karatta, Stun' Sail Boom River.

x*D. ulicina,* Sm.—(R. S. R.) Harvey's Return (Oct., 1908); (J. B. C.) Rocky River.

†*D. pectinata,* Lindl.—(J. B. C.) Rocky River.

D. incrassata, Sm.—(R. T.) K.I. (Waterhouse), Karatta.

D. genistifolia, A. Cunn.—(R. T.) Near Kingscote, between Eleanor and Stun' Sail Boom Rivers, Central Dudley Peninsula; (R. S. R.) Stokes' Bay, Western River (Oct., 1908); (J. B. C.) between Kingscote and Vivonne Bay, Rocky River.

D. brevifolia, Lindl.—(R. T.) Between American River and D'Estrees Bay, towards Eleanor River, De Mole River; (J. B. C.) between Kingscote and Vivonne Bay; (R. S. R.) Ritta's Lagoon (Oct., 1908), Timber Creek.

Eutaxia microphylla, (R. Br.) J. M. Black.—(R. T. as *E. empetrifolia*) Kingscote, Mount Pleasant, Eleanor and Harriet Rivers, Central Dudley Peninsula, Hog Bay River, De Mole River; (J. B. C.) Middle River, Vivonne Bay road, Rocky River; (R. S. R.) Stokes' Bay (Oct., 1908), Western River.

Pultenaea daphnoides, Wendl.—(R. T.) De Mole River; (Tepper) head of S.W. River; (R. S. R.) De Mole River (Oct., 1908); (J. B. C.) between Kingscote and Vivonne Bay, Rocky River.

P. scabra, R. Br. (uncertain).—(Tepper) Head of S.W. River; "known by a single specimen in leaf only, collected in 1886 near Birchman's (Birchmore's) Lagoon, and therefore uncertain" (Black's Flora).

P. teretifolia, H. B. Williamson, var. *brachyphylla,* H. B. Will.—Harriet River (coll. J. G. O. Tepper).

P. involucrata, Benth.—*P. prostrata* in Tepper's List, Queenscliff, is this species (Tate).

P. rigida, R. Br.—(Tepper as var. *angustifolia,* F. v. M.) Mount Taylor; K.I. in Black's Flora; (R. S. R.) Western River (Oct., 1908); (J. B. C.) Rocky River.

P. villifera, Sieb., var. *glabrescens,* J. M. Black.—Western River in Black's Flora; (T. G. B. O.) Cape du Couëdic (Nov., 1923). *P. villifera* of Tepper's List, Harriet River, is *P. canaliculata,* probably *(teste* Tate ?) this variety.

†*P. laxiflora,* Benth.—(J. B. C.) Rocky River, between Kingscote and Vivonne Bay.

†*P. laxiflora,* var. *pilosa,* H. B. Williamson.—(J. B. C.) Between Kingscote and Vivonne Bay.

P. acerosa, R. Br.—(R. T.) Near D'Estrees Bay, Central Dudley Peninsula.

P. acerosa, var. *acicularis*, H. B. Williamson.—Harriet River (coll. T. G. B. Osborn).

P. densifolia, F. v. M.—Harriet River (coll. J. G. O. Tepper).

P. trifida, J. M. Black.—Snug Cove and telegraph track 12 miles east of Cape Borda (coll. H. Griffith), head of Cygnet River (coll. J. G. O. Tepper); (J. B. C.) between Kingscote and Vivonne Bay.

P. vestita, R. Br.—Near Karatta (coll. Mrs. Ayliffe).

P. viscidula, Tate.—(R. T.) De Mole River; (J. B. C.) Rocky River; (T. G. B. O.) Hundred of Ritchie and Breakneck Creek (Nov., 1923).

P. tenuifolia, R. Br.—(R. T.) K.I. (Bannier).

P. cymbifolia, J. M. Black.—Between Kingscote and Hundred of Cassini (coll. H. W. Andrew).

[*P. aff. hibbertioides*.—(R. T.) Sugar-gum forests at Karatta.]

Phyllota pleurandroides, F. v. M.—(R. T.) K.I. (Waterhouse), south of Cygnet River, thence common to D'Estrees Bay and Stun' Sail Boom River; (J. B. C.) near Cape Borda, Rocky River.

Dillwynia hispida, Lindl.—(Tepper) Eleanor River; (R. S. R.) Cape Borda.

D. floribunda, Sm.—(R. T.) K.I. (Waterhouse), near D'Estrees Bay, Dudley Peninsula (T. Willson), De Mole River; (R. S. R.) Rocky River, Cape du Couëdic (Oct., 1908), De Mole River (Oct., 1908), Western River, Stokes' Bay (Oct., 1908); (J. B. C.) between Kingscote and Vivonne Bay, Rocky River (plant with rose-coloured flowers).

Platylobium obtusangulum, Hook.—(R. T.) K.I. (Waterhouse), Eleanor River to Karatta, De Mole River; (R. S. R.) Middle River, Stokes' Bay, Western River (Oct., 1908); (J. B. C.) between Kingscote and Vivonne Bay.

Templetonia retusa, (Vent.) R. Br.—(Tepper as *Templetonia*, probably *T. retusa*) West of Mount Thisbe, K.I. (in Black's Flora).

Goodia lotifolia, Salisb.—(R. T. as *G. medicaginea*) K.I. (Waterhouse), Kingscote, Cygnet River, throughout Dudley Peninsula; (J. B. C.) Kingscote, Rocky River, Ravine des Casoars; (R. S. R.) De Mole River, Cape du Couëdic, Harvey's Return, Middle River (Oct., 1908).

*x*Trifolium procumbens*, L.—(J. B. C.) Middle River.

**Melilotus indica*, All.—(R. T. as *M. parviflorus*) Dudley Peninsula; (J. B. C.) Rocky River.

**Medicago denticulata*, Willd.—(R. T.) Dudley's Peninsula.

Lotus australis, Andr.—(R. T.) K.I. (Waterhouse), Hog Bay River; (J. B. C.) Pennington Bay.

Swainsona lessertiifolia, DC.—(R. T.) Hog Bag, American Beach to Hog Bay River, American River, Eleanor River, Mount Mary; (J. B. C.) Middle River, Rocky River, Cape du Couëdic (Nov.); (R. S. R.) Stokes' Bay, Ravine des Casoars (Oct., 1908).

**Vicia sativa*, L.—(R. T.) Dudley Peninsula; (J. B. C.) K.I.

*†*V. sativa*, var. *angustifolia*, Wahl.—(J. B. C.) Between Vivonne Bay and Rocky River.

Kennedya prostrata, R. Br.—(R. T.) Mount Pleasant to Eleanor River, De Mole River; (J. B. C.) K.I.; (R. S. R.) Middle River (Oct., 1908).

Hardenbergia monophylla, (Vent.) Benth.—(R. T. as *Kennedya monophylla*) South-west of Rocky Point, Dudley Peninsula, American River; (R. S. R.) Cape du Couëdic and Stokes' Bay (Oct., 1908), Western River, Rocky River.

61. Geraniaceae.

Geranium pilosum, Forst., var. *potentilloides*, Benth. (var. *australe*, Ostenf.).—(R. T. as *G. Carolinianum*) Dudley Peninsula.

Erodium cygnorum, Nees.—(R. T.) K.I. in Fl. Austr.

**E. cicutarium*, (L.) L'Hér.—(R. T.) Dudley Peninsula.

Pelargonium australe, Willd. (R. T.) Dudley Peninsula; (R. S. R.) Cape du Couëdic (Oct., 1908).

P. australe, var. *erodioides*, Benth.—(R. T.) Kingscote, American River, D'Estrees Bay, Mount Mary, Dudley Peninsula; (J. B. C.) Rocky River, Kingscote, Vivonne Bay road.

62. OXALIDACEAE.

Oxalis corniculata, L.—(R. T.) Cygnet River, Dudley Peninsula; (R. S. R.) Harvey's Return; (J. B. C.) Rocky River, Bay of Shoals.

64. ZYGOPHYLLACEAE.

Nitraria Schoberi, L.—(R. T.) Kingscote, American Beach; (J. B. C.) Kingscote, The Spit (Beatrice Island).

Zygophyllum Billardieri, DC.—(R. T.) K.I. (R. Br.), D'Estrees Bay; (R. S. R.) Ravine des Casoars (Oct., 1908); (J. B. C.) Pennington Bay, Cape du Couëdic (Nov.).

Z. ammophilum, F. v. M.—(Tepper) Coast hills, Karatta; K.I. (R. S. R.).

[x?*Z. prismatothecum*, F. v. M.—(R. S. R., so identified by J. H. Maiden. Black gives this species for Leigh's Creek to Marree only) Cape du Couëdic Oct., 1908)].

65. RUTACEAE.

Zieria veronicea, F. v. M.—(R. T.) K.I. in Fl. Austr., between American River and D'Estrees Bay.

Boronia Edwardsii, Benth.—(R. T.) De Mole River; (Tepper) head of S.W. River; (R. S. R.) Stokes' Bay, Western River, Snug Cove (Oct., 1908); (J. B. C.) Rocky River.

B. caerulescens, F. v. M.—(R. T.) Between American River and D'Estrees Bay.

x*B. polygalifolia*, Sm.—(R. S. R.) Near Cape Borda (Sept., 1909).

B. filifolia, F. v. M.—(R. T.) K.I. (Waterhouse), D'Estrees Bay, Hawk's Nest and Mount Pleasant to Stun' Sail Boom River, Dudley Peninsula (T. Willson), De Mole River; (R. S. R.) Kingscote (Sept., 1908), Cape du Couëdic (Oct., 1908), S.W. River; (J. B. C.) between Kingscote and Vivonne Bay; (T. G. B. O.) Flinders Chase, on ironstone tablelands (Nov.).

B. palustris, Maid. et Black.—(R. T. as *B. parviflora*, probably), De Mole River, western part of K.I. in Black's Flora; (J. B. C.) in swamps, Breakneck River.

Correa aemula, (Lindl.) F. v. M.—(Tepper) Head of S.W. River; (J. B. C.) on banks of Breakneck River over water; (T. G. B. O.) banks of Rocky River in dense scrub (Nov.).

C. alba, Andr.—(R. T.) K.I. (Waterhouse), Dudley Peninsula, Kingscote (coll. R. S. Rogers), Cygnet River, Western Cove to American River; (R. S. R.) Cape du Couëdic (Oct., 1908).

C. rubra, Sm.—(R. T. as *C. speciosa*) Cygnet River, between Birchmore's and White's Lagoons, Eleanor, Harriet, and Stun' Sail Boom Rivers, Mount Mary, De Mole River; (Tepper) Queenscliff to American Beach; (R. S. R.) Harvey's Return (Oct., 1908), Rocky River; (J. B. C.) Cape du Couëdic.

C. rubra, var. *glabra*, Benth.—(Tepper) Queenscliff; (R. S. R.) Middle River, Stokes' Bay (Oct., 1908), Western River, Parrot Paddock, Ravine des Casoars, Rocky River; (J. B. C.) Kingscote; (T. G. B. O.) Flinders Chase, Vivonne Bay (Oct.).

C. decumbens, F. v. M.—(R. T.) K.I. (Waterhouse); (J. B. C.) Breakneck River, Vivonne Bay.

Asterolasia muricata, J. M. Black.—On Kingscote road, near Mount Thisbe (coll. H. Griffith).

Eriostemon brevifolius, A. Cunn.—(R. T. as *E. difformis)* De Mole River; (R. S. R. as *E. difformis)* Stokes Bay, Middle River (Oct., 1908), Western River; (J. B. C.) near Vivonne Bay.

Phebalium pungens, (Lindl.) Benth.—De Mole River (coll. H. Griffith).

Microcybe pauciflora, Turcz.—(R. T. as *Eriostemon capitatus)* D'Estrees Bay, between Mount Pleasant and Eleanor River; (J. B. C.) between Kingscote and Vivonne Bay.

Geijera linearifolia, (DC.) Black.—(R. T. as *G. parviflora)* Kingscote, Bay of Shoals.

66. TREMANDRACEAE.

Tetratheca ericifolia, Sm.—(R. T.) K.I. (Heuzenroeder); (R. S. R.) Stokes' Bay, Middle River (Oct., 1908), Western River, Snug Cove; (J. B. C.) Rocky River (also a scabrous form as mentioned by Bentham); (T. G. B. O.) Flinders Chase, uncommon on ironstone tablelands (Nov.).

T. halmaturina, J. M. Black.—Cape Cassini (coll. H. Griffith); (J. B. C.) between Vivonne Bay and Rocky River, Rocky River.

67. POLYGALACEAE.

Comesperma volubile, Labill.—(R. T.) South parts of Dudley Peninsula, Western Cove, Kingscote, Salt Lagoon; (J. B. C.) Rocky River (Nov.), Kingscote.

C. calymega, Labill.—(R. T.) K.I. (Waterhouse), Central Dudley Peninsula, near D'Estrees Bay; (J. B. C.) Rocky River, between Kingscote and Vivonne Bay (Nov.).

C. polygaloides, F. v. M.—(R. T.) K.I. (Waterhouse).

68. EUPHORBIACEAE.

Phyllanthus australis, Hook. f.—(R. T.) White's Lagoon, Eleanor River; (J. B. C.) Rocky River, between Kingcote and Vivonne Bay.

P. thymoides, Sieb.—(R. T.) Central Dudley Peninsula (not given for S.A. in Black's Flora).

*†*Euphorbia peplus*, L.—(J. B. C.) Kingscote.

Adriana Klotzschii, (F. v. M.) Muell. Arg.—(R. T. as *A. quadripartita)* K.I. (Waterhouse), Hog Bay River, Mount Mary; (J. B. C.) Middle River, Rocky River, between Kingscote and Vivonne Bay.

Poranthera microphylla, Brongn.—(R. T.) Dudley Peninsula, American River; (J. B. C.) Rocky River.

P. ericoides, Klotzsch.—(R. T.) D'Estrees Bay, White's Lagoon, between Mount Pleasant and Eleanor River; (R. S. R.) Harvey's Return (Oct., 1908), Parrot Paddock; (J. B. C.) between Kingscote and Vivonne Bay.

Micranthemum demissum, F. v. M., var. *microphyllum*, Grüning.—Snug Cove (in Black's Flora). Tate's record of *M. hexandrum*, between Harriet and Eleanor Rivers, is this species; (J. B. C.) Rocky River; (T. G. B. O.) ironstone tablelands near Timber Creek (Oct.).

Beyeria Leschenaultii, (DC.) Baill.—(R. T. *B. opaca* refers probably to this species on the Island) Common on sandy and stony heath ground, bushy places and by the sea coast; K.I. (in Black's Flora); (J. B. C.) Vivonne Bay, between Kingscote and Vivonne Bay, Rocky River, Bay of Shoals.

B. subtecta, J. M. Black.—Cygnet River (in Black's Flora).

Bertya rotundifolia, F. v. M.—(R. T.) Cygnet River (Waterhouse), Kingscote to American River and Stun' Sail Boom River; (J. B. C.) Lower Cygnet River, Vivonne Bay; (R. S. R.) Stokes' Bay and Middle River (Oct., 1908), Western River.

70. STACKHOUSIACEAE.

Stackhousia monogyna, Labill.—(R. T. as *S. linariifolia.* Records of *S. flava* are probably also this species) Kingscote, Eleanor River, near D'Estrees Bay (as var. ?), De Mole River (as *S. flava);* (R. S. R.) Harvey's Return, Middle River, Stokes' Bay; (J. B. C.) Cape du Couëdic, Rocky River, between Kingscote and Vivonne Bay.

S. spathulata, Sieb.—(Tepper) Cape du Couëdic (coll. A. Molineux); (J. B. C.) Cape du Couëdic, Rocky River.

71. SAPINDACEAE.

Dodonaea viscosa, L.—(R. T.) K.I. (Sealey, Waterhouse). See under *D. attenuata;* (R. S. R.) Kingscote.

D. attenuata, A. Cunn.—(R. T. *D. viscosa,* chiefly in the form *attenuata)* Kingscote, Western Cove, American River, Hog Bay River, American Beach, in thickets in the elevated parts of the interior as between Birchmore's and White's Lagoons, along the banks of the south-western rivers and North Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) Kingscote; (T. G. B. O.) Flinders Chase, damp places near Rocky River.

D. Baueri, End.—(R. T.) About Kingscote to Emu Creek, American River; (J. B. C.) Kingscote.

D. bursariifolia, Behr. et F. v. M.—(Tepper) Ravine des Casoars.

D. humilis, End.—(R. T.) Near D'Estrees Bay, Eleanor River, Hog Bay River to Rocky Point, American Beach; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (R. S. R.) Cape du Couëdic (Sept., 1908); (J. B. C.) between Kingscote and Vivonne Bay, Rocky River.

72. RHAMNACEAE.

Pomaderris halmaturina, J. M. Black.—(J. M. B.) Cygnet River and Hog Bay River; (R. T. as *P. apetala,* obviously this species) K.I. (Waterhouse).

P. racemosa, Hook.—(R. T.) About American River and Mount Mary, near Rocky Point, American Beach; var., shady banks of the Cygnet River, gorge of the Hog Bay River and Deep Creek, Dudley Peninsula.

P. obcordata, Fenzl.—(R. T.) Sand-dunes, Mount Mary, between American Beach and Salt Lagoon, Dudley Peninsula; (R. S. R.) Timber Creek, Mount Pleasant (Oct., 1908), Parrot Paddock; (J. B. C.) Cape du Couëdic.

Trymalium Wayi, F. v. M. et Tate.—Near Kingscote (coll. H. Griffith).

Spyridium spathulatum, F. v. M.—(R. T. as *S. spathulatum)* K.I. (Waterhouse), Kingscote, American River, etc., to Stun' Sail Boom River, Central Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) Vivonne Bay road.

S. thymifolium, Reiss.—(R. T. as *S. obovatum)* Forest on the Stun' Sail Boom River; (Tepper as *Spyridium pomaderroides,* Reiss. (?), and *S. coactilifolium),* F. v. M., which, *teste* Tate, are *Cryptandra obovata, i.e., S. thymifolium)* Grassy Creek, scrub west of Harriet River.

S. vexilliferum, (Hook.) Reiss.—(R. T. as *S. vexilliferum)* American River, Kingscote, De Mole River; (J. H. M.) Hog Bay (from J. M. Black), Cape du Couëdic (coll. R. S. Rogers), Cape Borda (coll. R. S. Rogers); (R. S. R.) De Mole River, Rocky River.

S. vexilliferum, var. *latifolium*, Benth.—(J. B. C.) Several places on overland telegraph line to Cape Borda.

S. phylicoides, Reiss.—(J. B. C.) Vivonne Bay road, Rocky River.

S. eriocephalum, Fenzl.—(J. H. M.) Hog Bay (from J. M. Black).

S. eriocephalum, var. *glabrisepalum*, J. M. Black.—Cygnet River (coll. H. Griffith).

S. halmaturinum, F. v. M.—(R. T.) K.I. (Sealey), Freestone Hill Ra. (Waterhouse), Western Cove to American River and D'Estrees Bay, Cygnet River to the south-west coast, near Rocky River, Dudley Peninsula; (R. S. R.) S.W. River; (J. B. C.) Vivonne Bay, Rocky River, near Cape Borda.

S. halmaturinum, var. *scabridum*, (Tate) J. M. Black.—Between Kingscote and Karatta (coll. Mrs. Ayliffe), near Cape Borda (coll. S. A. White and H. Griffith); (Tepper as *Spyridium bifidum*, F. v. M., which, *teste* Tate, is *Cryptandra scabrida*, *i.e.*, *S. halmaturinum*, var. *scabridum)* Karatta; (J. B. C.) near Cape Borda.

S. halmaturinum, var. *integrifolium*, J. M. Black.—Near Harvey's Return (coll. H. Griffith); (J. B. C.) Cape Borda (March).

Cryptandra hispidula, Reiss.—(Tepper) Diggers' Camp, scrub south-west of Kinch's, Cygnet River (as *C. amara*, which, *teste* Tate, is *C. hispidula)*; (J. B. C.) telegraph line 20 miles east of Cape Borda (March), creek near Ravine des Casoars.

C. leucophracta, Schlecht.—(R. T. as *Spyridium leucophractum)* K.I.(Waterhouse), towards the Eleanor River.

C. Waterhousei, F. v. M.—(R. T. as *Spyridium Waterhousei)* At the foot of the Freestone Hill Range (Waterhouse), American River, White's Lagoon, thence to the forest of sugar-gum trees at Karatta, Central Dudley Peninsula, De Mole River; (J. B. C.) Vivonne Bay road, near Cape Borda; (R. S. R.) Kingscote, Middle River, Stokes' Bay.

74. Malvaceae.

Lavatera plebeja, Sims.—(R. T.) Hog Bay River; (J. B. C.) Rocky River.

**Malva rotundifolia*, L.—Tate records *M. rotundifolia*, as introduced, for Dudley Peninsula. (This is an error of very long standing for **M. parvifolia*, L., or **M. nicaeensis*, All.—J. M. B.)

Plagianthus spicatus, (Hook.) Benth.—(R. T.) Salt Lagoon, Emu Creek, between Kingscote and Cygnet River; (J. B. C.) Curly Creek on Vivonne Bay road, Rocky River, Bay of Shoals, Pennington Bay, American River.

75. Sterculiaceae.

Lasiopetalum discolor, Hook.—(R. T.) K.I. (Waterhouse), near Kingscote; (J. B. C.) Cape du Couëdic (Nov.) ; (R. S. R.) Cape du Couëdic, Ravine des Casoars; (T. G. B. O.) Flinders Chase.

L. Behrii, F. v. M.—(R. T.) K.I. (Waterhouse); (R. S. R.) Kingscote.

L. Baueri, Steetz.—(R. T.) K.I. (Waterhouse), Dudley Peninsula and westward to Kingscote and Stun' Sail Boom River; (J. H. M.) Hog Bay; (J. B. C.) Kingscote (Nov.); (T. G. B. O.) between Kingscote and Vivonne Bay.

L. Schulzenii, F. v. M.—(R. T.) K.I. (Waterhouse), near Rocky Point, at American Beach, American River, and elsewhere near the coast, rarely in the interior parts, De Mole River; (R. S. R.) Kingscote, Western River, Timber Creek, near Karatta, Harvey's Return; (J. B. C.) Kingscote (Nov.), between Kingscote and Vivonne Bay; (T. G. B. O.) Flinders Chase.

Thomasia petalocalyx, F. v. M.—(R. T.) K.I. (Waterhouse), American River, near D'Estrees Bay, Harriet, Eleanor and Stun' Sail Boom Rivers, Cygnet River, towards Freestone Hill Ra., De Mole River; (J. B. C.) Kingscote, between Kingscote and Vivonne Bay (Nov.); (T. G. B. O.) Flinders Chase.

76. DILLENIACEAE.

Hibbertia sericea, (R. Br.) Benth.—(R. T. as *H. densiflora*; see under *H. virgata*, var. *crassifolia*) Near American River; (R. S. R.) Cape du Couëdic (Oct., 1908), Parrot Paddock, Rocky River, Sandy Creek; (J. B. C.) Rocky River.

H. sericea, var. *major*, J. M. Black.—(J. M. B.) K.I.

H. sericea, var. *scabrifolia*, J. M. Black.—Cape Borda (coll. H. Griffith); (J. B. C.) Rocky River.

H. stricta, R. Br.—(R. T.) Common on sandy and stony heath ground, De Mole River; (J. H. M.) Hog Bay, Cape Borda (coll. R. S. Rogers;) (J. B. C.) Kingscote, Vivonne Bay road, Rocky River.

H. stricta, var. *glabriuscula*, Benth.—(J. B. C.) Vivonne Bay road.

H. stricta, var. *oblonga*, J. M. Black.—(J. M. B.) Ravine Creek.

H. Billardieri, F. v. M. (R. T.) Not uncommon on sandy heath ground. De Mole River; (R. S. R.) S.W. River, De Mole River, Harvey's Return, Western River (Oct., 1908); (J. B. C.) Vivonne Bay road, Rocky River.

H. virgata, R. Br.—(Tepper) Karatta; (R. S. R.) Harvey's Return (Oct., 1908), Parrot Paddock.

H. virgata, var. *crassifolia*, (Benth.) J. M. Black. American River (in Tate Herb. as "*H. densiflora* vel *stricta*").

H. fasciculata, R. Br.—(R. T. as *H. fascicularis*) Wet heath ground three miles east of Karatta, Harriet River; (R. S. R.) De Mole River (Oct., 1908); (J. B. C.) in grassy glade on bank of Rocky River, telegraph line 20 miles from Cape Borda.

77. GUTTIFERAE.

Hypericum gramineum, Forst. f.—(R. T., probably, as *H. japonicum*) Among rocks on the upland country about American Beach; K.I. (in Black's Flora); (Wood Jones) Rocky River.

79. FRANKENIACEAE.

Frankenia pauciflora, DC.—(R. T. as *F. laevis*) Bay of Shoals, Nepean Bay, Flour-cask Bay, Pelican Lagoon; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) mouth of Cygnet River, Middle River.

80. VIOLACEAE.

Viola hederacea, Labill.—(R. T.) K.I. (Waterhouse), De Mole River; (R. S. R.) Ravine des Casoars; (J. B. C.) Cape du Couëdic, Rocky River.

x*V. Sieberiana*, Spreng.—(J. B. C.) Rocky River.

81. THYMELAEACEAE.

Pimelea glauca, R. Br.—(Tepper) Coast hills, Karatta; (J. H. M.) Cape Borda (coll. R. S. Rogers), Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) Vivonne Bay road, Rocky River.

P. stricta, Meisn.—(R. T.) K.I. (Heuzenroeder); (R. S. R.) Stokes' Bay Middle River, S.W. River.

P. spathulata, Labill.—(R. T.) Near American River, Kingscote (coll. R. S. Rogers), Dudley Peninsula, De Mole River.

P. macrostegia, (Benth.) J. M. Black.—(J. M. B.) K.I.; (R. T. has *P. ligustrina)* Sandy scrub, K.I. (Waterhouse), Hawk's Nest, Eleanor River, De Mole River; (R. S. R.) S.W. River, Ritta's Lagoon; (J. B. C.) Vivonne Bay road.

[*P. microcephala*, R. Br.—(R. T.) K.I. (R. Brown). In spite of R. Brown's record its occurrence seems doubtful. In Black's Flora the species is given for Murray lands and north thereof.]

P. flava, R. Br.—(R. T.) Near American River (Waterhouse), Mount Pleasant to the Eleanor River, Central Dudley Peninsula, De Mole River; (J. B. C.) Rocky River; (R. S. R.) Middle River, Western River, Sandy Creek; (T. G. B. O.) Harriet River (Oct.).

P. serpyllifolia, R. Br.—(R. T.) Kingscote (coll. R. S. Rogers), between American River and D'Estrees Bay, Vivonne Bay, coast tracts of Dudley Peninsula; (J. B. C.) Kingscote, between Vivonne Bay and Rocky River, Middle River; (R. S. R.) Ravine des Casoars.

P. curviflora, R. Br.—(R. T.) Hog Bay River.

P. octophylla, R. Br.—(R. T.) K.I. (Waterhouse), Cygnet River, Redbanks to American River and D'Estrees Bay and along the south coast, De Mole River; (R. S. R.) Stokes' Bay, Middle River, Sandy Creek; (J. B. C.) Vivonne Bay Road; (T. G. B. O.) Flinders Chase (Nov.).

P. phylicoides, Meisn.—(R. T.) Between American River and D'Estrees Bay, De Mole River; (J. B. C.) Vivonne Bay road, Rocky River.

82. Lythraceae.

x*Lythrum Hyssopifolia*, L.—(J. B. C.) Lower Cygnet River.

83. Myrtaceae.

Baeckea ramosissima, A. Cunn.—(Tepper as *B. diffusa*, Sieb.) Dudley Peninsula; (R. T. as *B. diffusa)* De Mole River; (J. B. C.) Rocky River; (R. S. R.) Harvey's Return, Western River.

B. ericaea, F. v. M.—(R. T. as *B. crassifolia*, probably really *B. ericaea)* K.I. (Waterhouse).

Leptospermum coriaceum, (F. v. M.) Cheel.—(R. T. as *L. laevigatum)* K.I. (Fragm. Phyt.); (Tepper as *L. erubescens*, which, *teste* Tate, is *L. laevigatum, i.e., L. coriaceum)* head of S.W. River.

L. scoparium, Forst. et f.—(R. T.) K.I. (Waterhouse), common on the wet sandy heaths of the main mass of the Island, De Mole River; (J. B. C.) between Vivonne Bay and Rocky River, telegraph line to Cape Borda.

L. pubescens, Lamk.—(R. T. as *L. lanigerum)* Margins of the south-western rivers; (J. B. C.) between Vivonne Bay and Rocky River, Stun' Sail Boom River, Rocky River, Squashy Creek (27 miles east of Cape Borda), widespread in marshes.

L. myrsinoides, Schl.—(R. T.) K.I. (Waterhouse), Stun' Sail Boom River; (J. B. C.) Vivonne Bay road.

Kunzea pomifera, F. v. M.—(R. T.) Sandhills, Vivonne Bay; (J. B. C.) Pennington Bay, between Vivonne Bay and Rocky River.

Callistemon rugulosus, DC.—(R. T. as *C. coccineus)* K.I. (in Fl. Austr.), claypans throughout the Island, Hog Bay River, Central Dudley Peninsula; (J. H. M. as *C. coccineus)* Hog Bay; (J. B. C.) Bay of Shoals, Middle River, Vivonne Bay road, widely spread; (T. G. B. O.) Rocky River (Nov.).

Melaleuca gibbosa, Labill.—(R. T.) K.I. (Waterhouse), Common on heathy ground and around claypans; (J. H. M.) Hog Bay, Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) near Vivonne Bay; (R. S. R.) Kingscote.

M. decussata, R. Br., var. *ovoidea,* J. M. Black.—(Tepper, probably, as *M. decussata)* Mount Tisbet; (J. B. C.) widespread on barren hills.

M. squarrosa, Donn.—(R. T.) K.I. (R. Brown); (J. H. M.) Kingscote.

M. acuminata, F. v. M.—(R. T.) K.I. (R. Brown, Waterhouse), Kingscote, common throughout Dudley Peninsula.

M. halmaturorum, F. v. M.—(R. T. as *M. pustulata)* K.I. (Waterhouse), generally distributed in salt swamps and by the sea, Murray's Lagoon, about Mount Pleasant; (J. B. C.) near salt water, widely distributed.

M. squamea, Labill. var. *glabra,* Cheel.—(Tepper as *L. squamea,* Labill) S.W. River; (J. B. C.) in swamps, Tin Hut and Squashy Creek (on telegraph line to Cape Borda), Rocky River.

M. pubescens, Schau.—(R. T. as *M. parviflora)* K.I. (Waterhouse), Kingscote to the Freestone Hill Ra., Mount Mary, common throughout Dudley Peninsula; (Tepper as *M. ericifolia,* Smith, which, *teste* Tate, is *M. parviflora)* Kingscote, Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) widely distributed, known as "Black Tea-Tree," Kingscote, Vivonne Bay road, etc.

M. uncinata, R. Br.—(R. T.) K.I. (Waterhouse), the chief constituent of the sandy heath ground, Central Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) abundant along the Vivonne Bay road, but not extending far along the telegraph line to Cape Borda.

M. fasciculiflora, Benth.—(J. B. C.) Prostrate shrubs a few inches high on exposed slopes at Cape du Couëdic and Cape Borda, 5 feet high and upright between Rocky and Breakneck Rivers.

[*M. cylindrica,* reported by Tate for "K.I., R. Brown," is an error as to locality, *vide* Black's Flora.]

Eucalyptus obliqua, L'Herit.—(R. T.) Dividing ridge between Birchmore's Lagoon and Mount Pleasant, De Mole River; (J. B. C.) Tin Hut (telegraph line to Cape Borda).

E. diversifolia, Bonpl.—(R. T. as *E. santalifolia)* K.I. (R. Br.), chiefly near the coast around Dudley Peninsula, Cygnet River, American River, White Lagoon; (J. B. C.) between Kingscote and Vivonne Bay, Rocky River (also as a small fruited form with clean stems on hills).

E. Baxteri, (Benth.) Maiden et Blakely.—(R. T. as *E. capitellata)* Between Mount Pleasant and Stun' Sail Boom River, De Mole River; (J. B. C.) telegraph line to Cape Borda, Rocky River.

[*E. largiflorens,* no author.—Cygnet River (Waterhouse), mentioned by Tate, cannot be the River Box of the Murray, *E. largiflorens,* F. v. M., syn. *E. bicolor,* A. Cunn. Perhaps it is *E. fasciculosa* (see Black's Flora)].

E. odorata, Behr et Schlecht.—(Tepper) Near Antechamber Bay.

[*E. hemiphloia,* K.I. (R. Brown), The Wells, Western Cove, Nepean Bay, of Tate's List, is not likely to be *E. microcarpa,* Maid., syn. *E. hemiphloia,* F. v. M., partly, of Black's Flora.]

E. leptophylla, F. v. M.—(Tepper as *E. uncinata,* Turcz.) Scrub west of the Harriet River; (R. S. R.) Harriet River, Timber Creek.

E. cneorifolia, DC.—(R. T.) K.I. (R. Brown), northern and western parts of Dudley Peninsula and westward along the north coast to Smith's Bay; (J. B. C.) near Kingscote to 24 miles on Vivonne Bay road, to American River, and to about 10 miles on the Middle Bay road at Wishanger.

E. oleosa, F. v. M.—K.I. (in Black's Flora).

E. cladocalyx, F. v. M.—(R. T. as *E. corynocalyx)* Freestone Hill Ra., American River, chief constituent of the forest growth on the Cygnet, Eleanor and other rivers, De Mole River; (J. B. C.) widely distributed on better land.

E. cosmophylla, F. v. M.—(R. T.) K.I. (Waterhouse), a chief constituent of the scrub on stony ground, from the Cygnet River to American River and Stun' Sail Boom River, De Mole River; (R. S. R.) Harriet River, Timber Creek; (J. B. C.) widely distributed.

E. rostrata, Schl.—(R. T.) Cygnet River (Waterhouse, Tate), Discovery Flat; (J. B. C.) Lower Cygnet River.

E. viminalis, Labill.—(R. T.) K.I. (R. Brown), Cygnet River among *E. corynocalyx;* (J. B. C.) Rocky River, Cygnet River.

E. angulosa, Schau.—(R. T. as *E. incrassata*, probably in part; see under *E. dumosa);* (J. B. C.) Rocky River.

E. conglobata, (R. Br.) Maiden, var. *anceps*, (R. Br.) Maiden.—(R. T., *E. incrassata*, probably in part; see under *E. dumosa);* (J. B. C.) Rocky River.

E. dumosa, A. Cunn.—(R. T. as *E. incrassata*, chiefly) K.I. (Baudin's Exped.), Freestone Hill Ra., Bay of Shoals, American River, Eleanor River. The varietal form *dumosa* constituted the chief mass of the mallee scrub throughout the Island; (J. B. C.) Cygnet River.

E. elaeophora, F. v. M.—(Tepper as *E. goniocalyx*, F. v. M.) Hog Bay River; K.I. (in Black's Flora).

E. ovata, Labill.—K.I. (in Black's Flora); (J. B. C.) on flats, Rocky River.

E. leucoxylon, F. v. M.—(R. T.) Western and southern parts of Dudley Peninsula, Twelve-tree Flat between Bay of Shoals and Cygnet River, banks of Cygnet, Eleanor, and Stun' Sail Boom Rivers (probably var. *macrocarpa* included); (J. B. C.) Eleanor River, Stun' Sail Boom River (probably var. *macrocarpa* included).

E. leucoxylon, var. *macrocarpa*, J. E. Brown.—K.I. (in Black's Flora).

E. calycogona, Turcz.—(R. T. as *E. gracilis*, probably) Stony heath ground from Mount Pleasant to Stun' Sail Boom River.

E. fasciculosa, F. v. M.—(R. T. as *E. paniculata)* Banks of the Cygnet River (Waterhouse); (J. B. C.) Rocky River.

[*E. Sieberiana*, F. v. M., recorded by Tepper for Harvey's Return and in Tate's Census for K.I. and the south-east of S.A., may be *E. vitrea*, R. T. Baker. The locality (Harvey's Return) will hardly fit *E. cneorifolia.*]

Darwinia micropetala, (F. v. M.) Benth.—(R. T.) K.I. (Bannier); (J. B. C.) Vivonne Bay, Rocky River, telegraph line to Cape Borda; (R. S. R.) Timber Creek.

Micromyrtus ciliata, (Sm.) J. M. Black.—(R. T. as *Thryptomene ciliata)* De Mole River.

Thryptomene ericaea, F. v. M.—(R. T.) K.I. (Bannier, Waterhouse), heath near Kingscote and American River; (J. B. C.) Vivonne Bay road; (R. S. R.) Ritta's Lagoon, Timber Creek.

Calythrix tetragona, Labill.—(R. T.) K.I. (in Fl. Austr.), Kingscote, Bay of Shoals, American River, Mount Pleasant to Karatta, Hog Bay River; (Tepper as *Calycothrix* sp. or var., which, *teste* Tate, is not distinct from *C. tetragona* except by its smaller pubescent leaves) west of Western River; (J. H. M.) Cape Borda (coll. R. S. Rogers); (J. B. C.) Cape Borda, Vivonne Bay, widely distributed; (R. S. R.) Stokes' Bay, Harvey's Return, Middle River, Western River.

Lhotzkya glaberrima, F. v. M.—(R. T.) K.I. (Bannier), sandy heath ground near D'Estrees Bay and from Mount Pleasant to Karatta; (J. B. C.) Vivonne Bay road, Vivonne Bay; (R. S. R.) Kingscote.

L. glaberrima, var. *magnisepala*, J. M. Black.—Middle and western end of K.I. (Black's Flora); (J. B. C.) near Cape Borda (March), Vivonne Bay road; (T. G. B. O.) Flinders Chase, sandy soil on road to Cape du Couëdic (Nov.).

L. Smeatoniana, F. v. M.—(Tepper) Karatta.

84. OENOTHERACEAE.

*x*Oenothera*, probably *O. odorata*, Jacq.—(J. B. C.) Rocky River.

x*Epilobium junceum*, Sol.—(J. B. C.) Rocky River.

E. glabellum, Forst.—(R. T., probably as *E. tetragonum*) Inundated ground throughout Dudley Peninsula, Discovery Flat, Cygnet River, Hawk's Nest, American River; K.I. (in Black's Flora); (T. G. B. O.) Flinders Chase, by waterhole in Rocky River (Oct.).

85. HALORRHAGIDACEAE.

Loudonia Behrii, Schlecht.—(R. T.) K.I. (Waterhouse), American River to Karatta, De Mole River; (R. S. R.) Kingscote, Middle River; (Tepper) Karatta (15/11/86); (J. B. C.) between Kingscote and Vivonne Bay, along telegraph line to Cape Borda, Rocky River.

[*L. aurea*, Lindl.—(Tepper) Banks of a lagoon south of the head of the S.W. River, head of Cygnet River to Karatta (4/3/86). Not given for K.I. in Black's Flora.]

Halorrhagis tetragyna, (Labill.) Hook. f.—(R. T.) Discovery Flat; (J. B. C.) Rocky River; (T. G. B. O.) Harriet River.

H. teucrioides, DC.—(R. T.) Kingscote to D'Estrees Bay and Eleanor River, Central Dudley Peninsula, De Mole River; (J. H. M.) Cape Borda (coll. R. S. Rogers); (J. B. C.) between Kingscote and Vivonne Bay, Lake Ada.

H. teucrioides, var. *meziana*, (Schind.) J. M. Black.—K.I. (in Black's Flora).

H. micrantha, (Thunb.) R. Br.—(J. B. C.) Squashy Creek (telegraph line to Cape Borda).

H. elata, A. Cunn.—In Tate's Census; ? (J. B. C.) Rocky River.

x*H. heterophylla*, Brongn.—(J. B. C.) Rocky River.

H. mucronata, (Nees) Benth.—(R. T.) K.I. (R. Brown).

H. Brownii, (Hook. f.) Schindl.—K.I. (in Black's Flora); (J. B. C.) Squashy Creek (27 miles east of Cape Borda).

H. acutangula, F. v. M.—(J. B. C.) In sandhills, Rocky River.

Myriophyllum amphibium, Lab.—(J. B. C.) Creek near Ravine des Casoars (March, 1926).

M. propinquum.—(R. T. as *M. variifolium*) Eleanor and Stun' Sail Boom Rivers; (J. B. C.) Rocky River, Squashy Creek (27 miles east of Cape Borda).

M. elatinoides, Gaud.—(R. T.) Cygnet River; (T. G. B. O.) Flinders Chase, waterhole in Rocky River (Nov.).

M. Muelleri, Sond.—(Tepper) Stun' Sail Boom River (Oct., 1886); (J. B. C.) Lower Cygnet River; (T. G. B. O.) fresh-water swamp near Harriet River (Nov.).

UMBELLIFERAE.

Centella asiatica, (L.) Urb.—(R. T. as *Hydrocotyle asiatica*) Cygnet and Eleanor Rivers.

x*Xanthosia pusilla*, Bunge.—(J. B. C.) Rocky River.

X. dissecta, Hook. f.—(R. T.) K.I. (in Fl. Austr.), near American River, Eleanor River; (Tepper) Mount Pleasant to Birchmore's Lagoon (8/11/86), Ravine des Casoars (28/2/86); (J. B. C.) Rocky River.

Hydrocotyle laxiflora, DC.—(R. T.) Under *Eucalyptus leucoxylon* in the gorge of the Hog Bay River.

H. hirta, R. Br.—(R. T.) Thickets, White Gum Valley, Dudley Peninsula.

H. comocarpa, F. v. M.—(Tepper) K.I.

H. tripartita, R. Br.—(R. T.) Cygnet, Eleanor and Stun' Sail Boom Rivers.

H. callicarpa, Bunge.—(R. T.) Mossy banks in gullies, under shade of thickets, and wet heath ground, Central Dudley Peninsula; (Tepper) Karatta (15/11/86); (J. B. C.) Rocky River.

H. crassiuscula, F. v. M.—(R. T.) Heath ground, Central Dudley Peninsula; (J. B. C.) Rocky River (Nov.).

H. capillaris, F. v. M.—(R. T.) K.I. (in Fl. Austr.), wet banks of creeks. Dudley Peninsula, on burnt heath ground, Central Dudley Peninsula.

H. diantha, DC.—(Tepper) Karatta (9/11/86).

Didiscus pusillus, (DC.) F. v. M.—(R. T.) Near Rocky Point, Dudley Peninsula.

Lilaeopsis australica, (F. v. M.) A. W. Hill.—(R. T. as *Crantzia lineata*) Harriet River, Cygnet and Eleanor Rivers.

Eryngium rostratum, Cav.—K.I. (in Black's Flora).

E. vesiculosum, Labill.—(R. T.) Birchmore's Lagoon, Hawk's Nest, Eleanor and Stun' Sail Boom Rivers; (Tepper) Karatta (5/3/86).

Daucus glochidiatus, (Labill.) Fisch.—(R. T. as *D. brachiatus*) Emu Creek, Kingscote, De Mole River, Western Cove, American River, throughout Dudley Peninsula; (Tepper) Karatta (16/11/86).

**Torilis nodosa*, (L.) Gaertn.—K.I. (in Black's Flora).

Trachymene heterophylla, F. v. M.—(R. T.) Between American River and D'Estrees Bay, White Lagoon, Eleanor River; (J. B. C.) Cape Borda.

Apium australe, Pet.-Thou.—(R. T. as *A. prostratum*) Salt Lagoon, Bay of Shoals, etc., seacliffs on the south coast, Cygnet, Eleanor, and other rivers, throughout Dudley Peninsula, De Mole River; (J. H. M.) Hog Bay; (Tepper) Karatta (15/11/86); (J. B. C.) Middle River; (T. G. B. O.) Cape du Couëdic.

*x*Foeniculum vulgare*, Mill.—(J. B. C.) Bay of Shoals.

87. Epacridaceae.

Styphelia exarrhena, F. v. M., var. *hirtella*, J. M. Black.—(Tepper as *Styphelia hirtella*) Scrub lands, Mount Pleasant.

Astroloma humifusum, (Cav.) R. Br.—(R. T. as *Styphelia humifusa*) K.I. (in Fl. Austr.), common on heaths, sandhills at Mount Mary; (J. B. C.) Vivonne Bay.

A. conostephioides, (Sond.) F. v. M.—(R. T. as *Styphelia Sonderi*) K.I. (in Fl. Austr.), heathy grounds at American River, Mount Pleasant, Eleanor River and Central Dudley Peninsula, De Mole River; (J. H. M.) Cape Borda (coll. R. S. Rogers); (J. B. C.) K.I.; (T. G. B. O.) Flinders Chase, in dense scrub (Oct. and Nov.).

Lissanthe strigosa, (Sm.) R. Br.—(R. T. as *Styphelia strigosa*) Mount Pleasant; (R. S. R.) Middle River, Timber Creek, Stokes' Bay, Mount Pleasant.

Leucopogon parviflorus, (Andr.) Lindl.—(R. T. as *L. Richei*) K.I. (in Fl. Austr.), sand-dunes, Nepean Bay, American River, Vivonne Bay, American Beach; (R. S. R. as *L. Richei*) Ravine des Casoars.

?*L. lanceolatus*, (Sm.) R. Br.—See remarks in Black's Flora on a small specimen from Rocky River, K.I., which may be this species.

L. hirsutus, Sond.—(Tepper as *Styphelia hirsuta*, F. v. M.) On the banks of swampy rivulets; K.I. (in Black's Flora).

L. costatus, F. v. M.—K.I. (in Black's Flora).

L. concurvus, F. v. M.—(R. T. as *Styphelia concurva)* Stony heath ground, Harriet and American Rivers, stringy-bark scrubs near Birchmore's Lagoon, De Mole River; (T. G. B. O.) Flinders Chase.

L. rufus, Lindl.—(R. T. as *Styphelia rufa)* K.I. (Sealey, Waterhouse), sandy heath ground, near American River, Birchmore's Lagoon to Mount Pleasant and Karatta, Central Dudley Peninsula; (T. G. B. O.) Vivonne Bay (Oct.)

L. Woodsii, F. v. M.—(Tepper as *Styphelia Woodsi)* Limestone hills west of Mount Tisbet.

L. Clelandii, Cheel.—Described from Coonalpyn (in flower). A specimen from K.I. in fruit only appears to be the same species (Black's Flora).

(Styphelia striata, Spreng. *(L. striatus,* R. Br.), is given by Tate for heaths about American River and from Mount Pleasant to Karatta. In his Flora he refers it to his W. District (west of Lake Torrens). Perhaps a confusion with *L. costatus.)*

Acrotriche serrulata, (Labill.) R. Br.—(Tepper as *Styphelia serrulata,* Lab., var.) Head of South-western, etc.; (J. B. C.) Middle River.

A. patula, R. Br.—(R. T. as *Styphelia patula)* K.I. (in Fl. Austr.), Western Cove, stony ridge south of Rocky Point, Dudley Peninsula.

A. cordata, (Labill.) R. Br.—(R. T. as *Styphelia ovalifolia)* Sand-dunes, Vivonne Bay.

A. depressa, R. Br.—(R. T. as *Styphelia depressa)* K.I. (R. Brown), widely distributed, Dudley Peninsula, Kingscote, White Lagoon, etc; (J. B. C.) Bay of Shoals, telegraph line to Cape Borda, etc.; (T. G. B. O.) Flinders Chase, in dense scrub.

A. fasciculiflora, (Regel.) Benth.—(R. T.) De Mole River; (Tepper) Grassy Creek.

Brachyloma ericoides, (Schlecht.) Sond.—(R. T.) K.I. (in Fl. Austr.), sandy heath ground between American River and D'Estrees Bay.

Epacris impressa, Labill.—(R. T.) De Mole River, S.W. River (coll. Tepper); (J. B. C.) near swamps in centre of the Island; (R. S. R.) Middle River, Stokes' Bay, Western River, Rocky River, Snug Cove.

Sprengelia incarnata, Sm.—(R. T.) S.W. River (coll. Tepper); (J. B. C.) Squashy Creek (27 miles east of Cape Borda) and other swamps along the telegraph line; (T. G. B. O.) Flinders Chase, peaty swamp near boundary at Rocky River.

88. PRIMULACEAE.

**Anagallis arvensis,* L.—(R. T.) Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) K.I.

*†*A. femina,* Mill.—(J. B. C.) Cygnet River.

Samolus repens, (Forst.) Pers.—(R. T.) Cygnet River, Bay of Shoals, Murray's Lagoon, Eleanor River, Salt Lagoon, seacliffs at Hog Bay River, Dudley Peninsula; (J. B. C.) Middle River, cliffs at Cape du Couëdic.

91. LOGANIACEAE.

Mitrasacme paradoxa, R. Br.—(R. T.) Mossy banks and wet sandy heath ground, Dudley Peninsula, De Mole River; (Tepper) Karatta (15/11/86).

M. distylis, F. v. M.—(R. T.) K.I. (coll. Tepper, recorded by Baron von Mueller, Vict. Naturalist, 2-1889).

Logania crassifolia, R. Br.—(R. T.) Seacliffs, D'Estrees Bay; (J. B. C.) Vivonne Bay, cliffs at Cape du Couëdic.

L. ovata, R. Br. (R. T.) K.I. (Waterhouse), American River, White's Lagoon, Mount Pleasant to Karatta, between Rocky Point and Salt Lagoon, Dudley Peninsula, De Mole River; (Tepper, ?*L. crassifolia*) Karatta (15/11/86), Ravine des Casoars; (J. B. C.) Cygnet River, Rocky River, between Kingscote and Vivonne Bay; (R. S. R.) De Mole River, Middle River, Stokes' Bay, Ravine des Casoars.

L. linifolia, Schlecht.—K.I. (in Black's Flora).

L. insularis, J. M. Black.—Cape Borda (Oct.) (in Black's Flora); (J. B. C.) Cape Borda.

92. Gentianaceae.

Sebaea ovata, R. Br.—(R. T.) K.I. (Heuzenroeder), Eleanor River, D'Estrees Bay, throughout Dudley Peninsula; (Tepper) Karatta (14/11/86); (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) Rocky River.

Erythraea australis, R. Br.—(J. H. M.) Hog Bay.

*x*E. Centaurium*, Pers.—(J. B. C.) Rocky River.

Villarsia exaltata, (Sims) F. v. M.—(Tepper as *Limnanthemum* sp., probably) Ravine des Casoars; (Tepper Herb.) Karatta (16/11/86), head of S.W. River (3/3/86); (J. B. C.) Squashy Creek (27 miles east of Cape Borda), Rocky River; (T. G. B. O.) Harriet River, Flinders Chase (Breakneck River).

93. Apocynaceae.

Alyxia buxifolia, R. Br.—(R. T.) Seacliffs, Bay of Shoals, Kingscote, Western River, American River; (J. H. M.) Kingscote; (J. B. C.) Kingscote, Middle River.

95. Convolvulaceae.

Convolvulus erubescens, Sims.—(Tepper) Coast hills, Karatta (12/11/86), Bay of Shoals, Queenscliffe (20/11/86); (J. B. C.) Kingscote.

Dichondra repens, Forst. et f.—(R. T.) Throughout Dudley Peninsula, Freestone Hill Range, Kingscote, American River, Eleanor River; (Tepper) Karatta (15/11/86); (J. B. C.) Cygnet River.

Wilsonia humilis, R. Br.—(R. T.) Salt Lagoon by Pelican Lagoon.

W. rotundifolia, Hook.—(R. T.) Bay of Shoals and Salt Lagoon, Murray's Lagoon.

W. Backhousei, Hook. f.—(R. T.) Margin of Salt Lagoon by Flour-cask Bay.

96. Borraginaceae.

Halgania lavandulacea, Endl.—(Tepper) Head of the S.W. River to Ravine (28/11/86).

Myosotis australis, R. Br.—(R. T.) Shady gullies and thickets throughout Dudley Peninsula, De Mole River; (Tepper) Karatta (2/11/86).

**Lithospermum arvense*, L.—(R. T.) Dudley Peninsula.

98. Labiatae.

Ajuga australis, R. Br.—(R. T.) K.I. (Waterhouse), Cygnet River, Hog Bay River.

**Marrubium vulgare*, L.—(R. T.) K.I.; (J. H. M.) Kingscote; (J. B. C.) Bay of Shoals, Pennington Bay.

Scutellaria humilis, R. Br.—(R. T.) K.I. (R. Brown, Sealey), thickets on the sand-dunes at Hog Bay and American Beach, at Hog Bay River, Mopehawk Gully.

Prostanthera spinosa, F. v. M.—(R. T.) Near Wallan's Hut and Cygnet Bay (Waterhouse, in Frag. Phyt.), bushy places, Cygnet and Stun' Sail Boom Rivers, etc., heath ground from Mount Pleasant to Karatta, De Mole River; (Tepper) Diggers' Camp (26/2/86), Karatta (Nov., 1886), Cygnet River (28/2/86); (J. H. M.) Cape Borda (coll. R. S. Rogers; (J. B. C.) between Kingscote and Vivonne Bay; (R. S. R.) Ritta's Lagoon, Harvey's Return, Middle River; (T. G. B. O.) Flinders Chase, in dense scrub (28/10/24).

P. aspalathoides, A. Cunn.—(R. T. as *P. coccinea*, see below) Sandy scrub (Waterhouse), common about Kingscote and American River, near Rocky Point, Dudley Peninsula; K.I. (in Black's Flora).

P. microphylla, (R. Br.) A. Cunn.—(R. T. as *P. coccinea*, see above); K.I. (in Black's Flora).

P. chlorantha, F. v. M.—(R. T.) Cygnet River (Waterhouse); (J. B. C.) between Kingscote and Vivonne Bay (Nov.).

Westringia angustifolia, R. Br.—(R. T., *W. rigida*, refers to this species or the following or both) Dudley Peninsula (T. Willson).

W. Dampieri, R. Br.—Coast of K.I. (in Black's Flora).

99. Solanaceae.

Solanum nigrum, L. (J. H. M. ?) Kingscote; (J. B. C.) Wishanger.

S. simile, F. v. M.—(R. T.) K.I. (R. Brown), towards Kangaroo Head and Hog Bay River, Kingscote, American River, Eleanor River; (Miss Featherstone) MacGillivray (Sept.); (J. B. C.) Rocky River, Kingscote, Vivonne Bay road.

*S. *sodomaeum*, L.—(R. T.) K.I.; (J. H. M.) Hog Bay.

Lycium australe, F. v. M.—(J. H. M.) Kingscote, Hog Bay.

*x*L. ferocissium*, Miers.—(J. B. C.) Kingscote, Beatrice Island.

*x*Datura Stramonium*, L.—(J. B. C.) Kingscote.

Nicotiana suaveolens, Lehm.—(R. T.) By the sea shore (Leschenault), rocks by the sea, north and north-west coasts of Dudley Peninsula, gorge of the Hog Bay River.

Anthocercis myosotidea, F. v. M.—(R. T.) Wet sandy heath between American River and D'Estrees Bay.

100. Scrophulariaceae.

*x*Verbascum virgatum*, With.—(J. B. C.) Wishanger.

**Celsea cretica*, L. f.—(R. T.) K.I.

Mimulus repens, R. Br.—(R. T.) Hog Bay, Cygnet and Eleanor Rivers; (J. B. C.) Lower Cygnet River.

Gratiola peruviana, L.—(R. T.) K.I. (Waterhouse), Cygnet and Stun' Sail Boom Rivers; (J. B. C.) Cygnet River, Rocky River.

Limosella aquatica, L.—(R. T.) K.I. (R. Brown).

Glossostigma spathulatum, Wight et Arn.—Creeks and swamps, K.I. (in Black's Flora).

Veronica Derwentia, Andr.—(Tepper) Ravine des Casoars; (J. B. C.) Rocky River, Ravine des Casoars.

V. distans, R. Br.—(R. T.) Sand-dunes and calciferous sandrock, Hog Bay River, Rocky Point, American River, Mount Mary; (Tepper Herb.) Eleanor River (18/11/86), Karatta coast hills (12/11/88), Mount Taylor (13/11/86), Cape du Couëdic (coll. A. Molyneux) (14/11/86); (J. B. C.) Vivonne Bay, Cape du Couëdic (in bare soil, sending out rooting runners), Rocky River.

V. calycina, R. Br.—(R. T.) K.I. (Waterhouse).

Euphrasia collina, R. Br.—(R. T. as *E. Brownii*) Seacliffs, D'Estrees Bay; (Tepper Herb.) Karatta coast hills (12/11/86), cliffs, Cape du Couëdic (Nov.); (T. G. B. O.) Flinders Chase.

[*Buchnera linearis*, R. Br. ?—(J. H. M.) In fruit only, doubtful in absence of flowers, Cape du Couëdic (coll. R. S. Rogers).]

LENTIBULARIACEAE.

Utricularia dichotoma, Labill.—(Tepper) S.W. River, Karatta (17/11/86); (Tepper Herb.) head of Cygnet River (3/3/86); (J. B. C.) Breakneck River, Squashy Creek (27 miles east of Cape Borda).

Polypompholyx tenella, Lehm.—(R. T.) Margin of runnels on heathy ground, Central Dudley Peninsula.

106. MYOPORACEAE.

Myoporum insulare, R. Br.—(R. T.) By the coast around Dudley Peninsula, Nepean Bay, etc.; (J. H. M.) Hog Bay; (J. B. C.) common near the coast, between Kingscote and Vivonne Bay, Ravine des Casoars.

M. viscosum, R. Br.—(R. T.) K.I. (in Frag. Phyt.), Kingscote, American River, Cygnet, Eleanor and Stun' Sail Boom Rivers, sand-dunes at Mount Mary, common in the mallee scrub, Dudley Peninsula; (J. B. C.) Kingscote; (T. G. B. O.) Flinders Chase, in dense scrub by Rocky River, Harriet River.

M. parvifolium, R. Br.—(R. T.) Hawk's Nest; (J. B. C.) Rocky River.

Eremophila Behriana, F. v. M.—(R. T.) K.I. (Waterhouse), wet heath, D'Estrees Bay.

E. glabra, (R. Br.) Ostenf.—(R. T. as *E. Brownii*) K.I. (Waterhouse), common on heath and coast plains, rare in mallee scrub on the north coast of Dudley Peninsula; (R. S. R.) Kingscote; (J. B. C.) Kingscote.

107. PLANTAGINACEAE.

Plantago varia, R. Br.—(R. T.) K.I. (R. Brown as *P. parviflora*), (Waterhouse), Discovery Flat, Cygnet River, Eleanor River, Dudley Peninsula, De Mole River; (J. B. C.) Pennington Bay.

**P. lanceolata*, (R. T.) Dudley Peninsula; (J. B. C.) Cygnet River.

108. RUBIACEAE.

x*Opercularia scabrida*, Schl.—(J. B. C.) Rocky River.

O. hispida, Spr.—(J. H. M., determination doubtful, seeds like those of *O. aspera*) Hog Bay.

O. varia, Hook.—(R. T.) Central Dudley Peninsula, De Mole River; (Tepper as *O. ovata*, J. Hook., which, *teste* Tate, is this species) Karatta; (J. B. C.) Lake Ada, Kingscote, Vivonne road, Rocky River.

Asperula Gunnii, Hook. f.—(R. T. as *A. oligantha*, F. v. M.) K.I. (coll. Tepper), the leaves four in a whorl and broadly ovate; (J. B. C.) Rocky River (Nov.), Kingscote, Vivonne Bay road.

A. scoparia, Hook. f.—K.I. (in Black's Flora).

Galium umbrosum, Sol.—(R. T.) Western Cove, American River, Dudley Peninsula.

†*G. umbrosum*, Sol., var. *muriculatum*, Benth.—(J. B. C.) On tops of cliffs, Cape du Couëdic; (R. T. as *G. australe*) Western Cove, Dudley Peninsula.

G. Gaudichaudii, DC.—K.I. (in Black's Flora).

G. australe, DC.—(R. T.) K.I. (in Fl. Austr.).

G. ciliare, Hook. f.—(J. B. C.) Cape du Couëdic.

*x*G. murale*, DC.—(T. G. B. O.) Rocky River; (R. T. as *G. umbrosum*) Dudley Peninsula.

111. Dipsaceae.

*x*Scabiosa maritima*.—(J. B. C.) Kingscote.

113. Campanulaceae.

Lobelia rhombifolia, De Vriese.—(Tepper) Karatta, plentiful on burnt ground; (R. S. R.) Kingscote (Sept., 1908), Middle River (Oct., 1908); (J. B. C.) Kangaroo Island; (T. G. B. O.) Flinders Chase, by Breakneck River (Nov.).

L. gibbosa, Labill.—(R. T. as *L. microsperma*, F. v. M.) K.I. (Waterhouse), Cygnet River to Mount Pleasant, etc., grassy slopes by the sea, D'Estrees Bay; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers).

L. anceps, Thunb.—(R. T.) K.I. (Waterhouse), wet banks of Hog Bay, Cygnet, Eleanor and other western rivers, seacliffs, Hog Bay River; (J. B. C.) Cygnet River, Rocky River.

L. pratioides, Benth.

Pratia platycalyx, Benth.—(R. T.) Mud-banks of the Cygnet River.

Wahlenbergia gracilis, DC.—(R. T.) Cygnet River, American River, common throughout Dudley Peninsula, De Mole River; (J. B. C.) K.I.

114. Goodeniaceae.

Goodenia amplexans, F. v. M., var. *angustifolia*, Krause.—(R. T.) De Mole River; (J. H. M.) Cape Borda (coll. R. S. Rogers); (R. S. R.) Harvey's Return (Oct., 1908), Western River; (J. B. C.) Wishanger (March), Ravine des Casoars, Cape Borda.

G. ovata, Smith.—(R. T.) Cygnet River (Waterhouse, Tate), American River, Eleanor, Harriet and Stun' Sail Boom Rivers, Dudley Peninsula; (J. H. M.) Hog Bay, Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) Kingscote.

G. varia, R. Br.—(R. T.) Seacliffs of D'Estrees Bay; (R. S. R.) Kingscote (Oct., 1908), Cape du Couëdic (Oct., 1908); (J. B. C.) Cape Borda; (T. G. B. O.) Flinders Chase.

G. geniculata, R. Br.—(R. T.) Sandy heath ground by Cygnet River, at White Lagoon, Mount Pleasant, De Mole River; (R. S. R.) Cape du Couëdic (Oct., 1908), Middle River (Oct., 1908), Rocky River; (J. B. C.) K.I.

G. primulacea, Schlechtd.—(R. T.) Wet heath between American River and D'Estrees Bay.

Selliera radicans, Cav.—(R. T.) Cygnet River, Murray Lagoon, Eleanor and Stun' Sail Boom Rivers; (J. B. C.) K.I. (with rust); (Wood Jones) Rocky River.

Scaevola crassifolia, Lab.—(R. T.) Coast hills, Pennington Bay and eastward, Vivonne Bay; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) Middle River; (T. G. B. O.) Flinders Chase, amongst mallee.

S. aemula, R. Br.—(R. T.) About Mount Pleasant and towards Mount Mary, abundant over area of burnt heath, Central Dudley Peninsula, De Mole River; (J. H. M.) Cape Borda (coll. R. S. Rogers); (R. S. R.) Kingscote (Sept., 1908), Middle River (Oct., 1908), Western River, Rocky River; (T. G. B. O.) Stirling's, on ironstone tableland.

?*S. humilis*, R. Br.—(Tepper) Low ground near Lashmar's Lagoon and Antechamber Bay.

S. microcarpa, Cav.—(J. H. M.) Hog Bay.

S. linearis, R. Br.—(R. T.) K.I. (Waterhouse), wet sandy heath ground between American River and D'Estrees Bay; (J. B. C.) K.I.; (T. G. B. O.) Flinders Chase, on ironstone tableland.

Dampiera lanceolata, Cunn.—(R. T.) Near D'Estrees Bay, sandy ground by the sea near Rocky Point, Dudley Peninsula; (R. S. R.) S.W. River, near Karatta (Oct., 1908), Middle River (Oct., 1908), Stokes' Bay (Oct., 1908); (J. B. C.) K.I.

116. STYLIDIACEAE.

Stylidium graminifolium, Swartz.—(R. T. as *Candollea graminifolium*) Wet sandy heath near D'Estrees Bay and between the Harriet and Stun' Sail Boom Rivers; (J. B. C.) Rocky River, telegraph line to Cape Borda.

S. Tepperianum, F. v. M.—(Tepper) Mount Taylor, in fissures and hollows of the limestone filled with sand.

S. calcaratum, R. Br.—(R. T. as *Candollea calcarata*) Central Dudley Peninsula.

S. despectum, R. Br. (R. T. as *Candollea despecta*) Central Dudley Peninsula, De Mole River.

Levenhookia pusilla, R. Br.—(R. T. as *Leewenhoekia dubia*) Grassy slopes by the sea, north-west coast of Dudley Peninsula.

117. COMPOSITAE.

Olearia tubuliflora, Benth.—(Tepper as *Aster tubuliflorus*, F. v. M.) Sandy scrub near Brownlow, etc.

O. axillaris, F. v. M.—(R. T. as *Aster axillaris*) K. I. (R. Brown), near the coast, Kingscote and American River, widely distributed, Dudley Peninsula; (J. B. C.) Vivonne Bay, Middle River; (T. G. B. O.) Cape du Couëdic.

O. ramulosa, Benth.—(Tepper as *Aster ramulosus*, Labill.) Cape Willoughby (coll. Horswill); (J. H. M.) Hog Bay; (J. B. C.) Kingscote, widespread.

O. floribunda, Benth.—(R. T. as *Aster floribundus*) Harrier, Eleanor, Stun' Sail Boom and De Mole Rivers.

O. teretifolia, F. v. M.—(R. T. as *Aster teretifolius*) K.I. (Waterhouse), American River, White's Lagoon, generally distributed throughout Dudley Peninsula; (J. H. M.) Hog Bay, Cape Borda (coll. R. S. Rogers); (R. S. R.) Kingscote (Sept., 1908); (J. B. C.) Rocky River (Nov.).

O. rudis, F. v. M.—(R. T. as *Aster exsul*) Hog Bay River to American Beach and American River, Kingscote (coll. R. S. Rogers), and sand-dunes at Mount Mary; (J. H. M.) Kingscote; (R. S. R.) Ravine des Casoars (Oct., 1908); (J. B. C.) Kingscote (Nov.); (T. G. B. O.) Flinders Chase, near Rocky River H.S.

O. ciliata, F. v. M.—(R. T. as *Aster Huegelii*) K.I. (Waterhouse), American River and adjacent south coast, between Mount Pleasant and Eleanor River; (J. B. C.) between Kingscote and Vivonne Bay.

Vittadinia australis, Rich.—(R. T.) Kingscote and Salt Lagoon to Discovery Flat, Murray's Lagoon, Mount Mary, widely dispersed over Dudley Peninsula; (J. H. M.) Kingscote; (J. B. C.) Kingscote, Cape du Couëdic.

Achnophora Tatei, F. v. M.—(R. T.) Wet heathy ground, two miles east from Karatta, De Mole River; (T. G. B. O.) Harriet River, forming tussocks by salt creek.

Lagenophora stipitata, (Labill.) Druce.—(R. T. as *L. Billardieri*) Mossy banks in gullies and under shade of gum trees and thickets, Dudley Peninsula; (J. B. C.) Rocky River (Nov.).

L. Gunnii, (Hook. f.) n. comb. (*Emphysopus Gunnii*, Hook. f. (1847); *Lagenophora emphysopus*, Hook. f. (1860).)—(R. T. as *L. emphysopus*) Pasture slopes by the sea, south of Kangaroo Head.

Brachycome cuneifolia, Tate.—(R. T., "showing slight differences from the type") K.I. (coll. Tepper).

x*Siegesbeckia orientalis*, L.—(J. B. C.) Ravine des Casoars.

Cotula filifolia, Thunb.—(R. T.) Northern coast of Dudley Peninsula, basin of Deep Creek; (T. G. B. O.) Flinders Chase, in swamp of Rocky River.

C. coronopifolia, L.—(R. T.) K.I. (Waterhouse), Cygnet River, throughout Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) Cygnet River; (T. G. B. O.) Flinders Chase, in swamp of Rocky River.

C. australis, Hook. f.—(R. T.) Throughout Dudley Peninsula, towards Kangaroo Head; (J. B. C.) K.I.

Centipeda Cunninghami, F. v. M.—(R. T.) K.I. (Waterhouse), throughout the Island; (J. B. C.) Rocky River.

Isoetopsis graminifolia, Turcz.—(R. T.) Pasture slopes by the sea south of Kangaroo Head.

Myriocephalus rhizocephalus, Benth.—(R. T.) K.I. (Waterhouse), inundated ground, Cygnet River and Salt Lagoon.

Angianthus Preissianus, Benth.—(R. T.) Margins of the salt water creeks and clay flats throughout Dudley Peninsula.

A. strictus, Benth.—(R. T.) Pasture slopes by the sea, north and west coasts of Dudley Peninsula.

Calocephalus Brownii, F. v. M.—(R. T.) K.I (in Fl. Austr.), rocks by the sea, north-east coast of Dudley Peninsula, Kingscote and D'Estrees Bay, De Mole River; (J. H. M.) Hog Bay, Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) Middle River, Cape Borda.

Cassinia laevis, R. Br.—(R. T., also as *Humea punctulata* and as *Cassinia punctulata*, F. v. M. and Tate) Murray's Lagoon, on calciferous sandstone, Hog Bay River; (J. B. C.) Kingscote (?).

C. spectabilis, R. Br.—(R. T.) K.I. (in Fl. Austr.), on burnt ground, throughout Dudley Peninsula, American River, Kingscote, and Emu Creek, sparsely distributed as far west as Eleanor River; (J. H. M.) Kingscote; (J. B. C.) Bay of Shoals, Beatrice Island.

Eriochlamys Behrii, Sond. et F. v. M.—(R. T.) Cliffs by the sea, D'Estrees Bay, and near Hog Bay River.

Toxanthus Muelleri, Benth.—(R. T., by inadvertence recorded first as *T. perpusillus*) Grassy slopes by the sea, south of Kangaroo Head.

Millotia tenuifolia, Cass.—(R. T.) Sandy soil near the coast at Western Cove and American River, wet banks and thickets, Dudley Peninsula.

Ixiolaena supina, F. v. M.—(R. T.) K.I. (in Fl. Austr.), seacliffs around Dudley Peninsula and D'Estrees Bay, De Mole River; (J. H. M.) Hog Bay, Cape Borda (coll. R. S. Rogers); (R. S. R.) Cape du Couëdic (Oct., 1908), Harvey's Return (Oct., 1908).

Ixodia achilleoides, R. Br.—(R. T.) K.I. (in Fl. Austr.), very abundant throughout the Island, De Mole River; (J. H. M.) Hog Bay, Cape Borda (coll. R. S. Rogers, a very distinct form with narrow linear, almost filiform, leaves), Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) widespread, near Cape du Couëdic (Nov.).

Podosperma angustifolium, Labill.—(R. T.) Sand ridges, shores of Western Cove, American Beach and American River, sand-dunes at Mount Mary, in calciferous sandstone, Hog Bay River.

Podolepis rugata, Lab.—(R. T.) Seacliffs of D'Estrees Bay; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers); (J. B. C.) Rocky River, between Kingscote and Vivonne Bay (Nov.).

P. acuminata, R. Br.—(R. S. R.) Rocky River (Oct., 1908).

*x*Inula graveolens*, Desf.—(J. B. C.) K.I.

Helichrysum obtusifolium, Sond. et F. v. M.—(R. T.) K.I. (Waterhouse), near Western Cove, Nepean Bay, between Mount Pleasant and Eleanor River; as var. *tephrodes*, De Mole River; (R. S. R.) S.W. River (Oct., 1908), Timber Creek.

H. bracteatum, (Vent.) Andr.—(R. T. as *H. lucidum*) Smith's Bay; (R. S. R.) Stokes' Bay, Western River.

H. leucopsidium, DC.—(R. T.) Pasture slopes by the sea, D'Estrees Bay and towards Hog Bay River, sand-dunes, Vivonne Bay and American Beach; (T. G. B. O.) Cape du Couëdic, Kingscote.

H. adenophorum, F. v. M.—(R. T.) Scrub near Wallan's Hut (Waterhouse), Smith's Bay, heathy ground from Cygnet River to Mount Prospect, and the Stun' Sail Boom River; (J. B. C.) near Lake Ada, Cape Borda.

H. apiculatum, DC.—(Tepper) Coast hills, Karatta; (J. B. C.) Middle River; (T. G. B. O.) Vivonne Bay.

H. semipapposum, DC.—(R. S. R.) Western River.

H. retusum, Sond. et F. v. M.—(R. T.) Heathy ground at Kingscote, and Red-banks to American River, mallee scrub, North Dudley Peninsula, near Rocky Point; (J. H. M.) Kingscote, Hog Bay; (J. B. C.) Kingscote (Nov.).

Helipterum exiguum, F. v. M.—In Tate's Census for K.I.

H. australe, (A. Gray) Ostenf.—(R. T. as *H. dimorpholepis*) Grassy slopes by the sea, south of Kangaroo Head.

Gnaphalium luteo-album, L.—(R. T.) K.I. (in Fl. Austr.), American River and about Mount Mary, widely dispersed over Dudley Peninsula; (R. S. R.) Harvey's Return (Oct., 1908).

Gn. japonicum, Thunb.—(R. T.) K.I. (Waterhouse), Discovery Flat, White's Lagoon, Eleanor River, common on Dudley Peninsula, De Mole River; (J. H. M.) Hog Bay; (J. B. C.) Cygnet River.

Gn. indutum, Hook. f.—(R. T.) Cliff slopes in the north and west coasts, clay flats and under shade of thickets, Dudley Peninsula.

Stuartina Muelleri, Sond.—(R. T.) Dudley Peninsula (as for *Gnaphalium indutum*) De Mole River.

Erechthites prenanthoides, DC.—(R. T.) Sandy ground, Cygnet River, sparsely distributed throughout Dudley Peninsula, De Mole River; (R. S. R.) Harvey's Return (Oct., 1908).

E. picridioides, Turc.—In Tate's Census for K.I.; (J. B. C.) Rocky River (March); (T. G. B. O.) Flinders Chase (Oct.).

E. arguta, DC.—(R. T.) K.I. (in Fl. Austr.), Kingscote, Cygnet River.

E. quadridentata, DC.—(R. T.) Open mallee scrub and extending to heathy ground, North Dudley Peninsula.

†*Senecio magnificus*, F. v. M. (J. B. C.) Breakneck River.

S. lautus, Sond.—(R. T.) K.I. (in Fl. Austr.), seacliffs D'Estrees Bay to Hog Bay River, north coast of Dudley Peninsula, sand-dunes of Vivonne Bay; (J. H. M.) Cape du Couëdic (coll. R. S. Rogers, very succulent); (R. S. R.) Cape du Couëdic (Oct., 1908), Ravine des Casoars; (J. B. C.) Rocky River.

S. Georgianus, DC.—In Tate's Census for K.I.; (T. G. B. O.) Vivonne Bay (26/10/24).

S. odoratus, Horn.—(R. T.) K.I. (R. Brown), bushy places, widely distributed; (J. H. M.) Kingscote; (J. B. C.) Rocky River, Kingscote.

S. Cunninghamii, DC.—(R. T.) Ravine des Casoars (coll. Tepper); (J. B. C.) Ravine des Casoars, between Kingscote and Vivonne Bay, Rocky River.

Cymbonotus Lawsonianus, Gaud.—(R .T.) Natural pasture lands and grassy glades in mallee scrub throughout Dudley Peninsula, De Mole River.

**Cryptostemma calendulaceum*, R. Br.—(R. T.) Dudley Peninsula; (J. H. M.) Hog Bay; (J. B. C.) K.I.

**Silybum marianum*, Gaertn.—(J. H. M. as *Carduus marianus*, L.) Hog Bay.

**Onopordon acanthium*, L.—(R. T.) Dudley Peninsula, "known during the last two or three years *(i.e.*, about 1880) about the Gap."

**Cirsium lanceolatum*, Scop.—(J. H. M. as *Carduus lanceolatus)*, Hog Bay; (J. B. C.) Kingscote.

*x*Carduus tenuiflorus*, Curtis.—(J. B. C.) K.I.

**Centaurea melitensis*, L.—(R. T.) Dudley Peninsula; (J. H. M.) Hog Bay.

Microseris scapigera, (Forst.) Schultz-Bip.—(Tepper as *M. Forsteri)* Coast hills, Karatta, and at the coast, Queenscliffe, but rare and very dwarfed; (T. G. B. O.) Flinder Chase, in sandy soil near Rocky River (27/1/23).

*x*Hypochaeris radicata*, L.—(J. B. C.) Kingscote.

**H. glabra*, L.—(R. T.) Dudley Peninsula; (J. B. C.) K.I.

**Sonchus oleraceus*, L.—(R. T.) Dudley Peninsula; (J. B. C.) K.I.

x*S. asper*, Hill, var. *littoralis*, J. M. Black.—(J. B. C.) Pennington Bay; (T. G. B. O.) Cape du Couëdic (Nov.).

**Picris hieracioides*, L.—(R. T.) K.I. (Waterhouse), Discovery Flat, Dudley Peninsula.

NOTES ON A COLLECTION OF AUSTRALIAN MYXOMYCETES.

(Identified by Miss Gulielma Lister.)

By J. Burton Cleland, M.D.

[Read April 14, 1927.]

During the collection of Basidiomycetes in Australia, the writer has preserved a number of Myxomycetes, of which he submitted duplicate specimens to Miss G. Lister, who kindly reported on them. He has now arranged the results of Miss Lister's identifications, adding where possible the exact localities and dates where and when the specimens were obtained. He has also added, where these were noted, the colours and some other macroscopic features, as well as his own notes on the size and characters of the spores as these were examined shortly after collection. The gatherings contained altogether 31 species. Miss Lister records *Badhamia foliicola*, *B. capsulifera*, *Physarum reniforme*, *P. didermoides* (probably), *P. cinereum*, and *Mucilago spongiosa* as new for Australia, and several species as new for particular States.

Ceratiomyxa fruticulosa, (Muell.) Macbr.—Branches with numerous projecting spines 12 μ long. Spores very white, finely granular, subspherical to oval or egg-shaped. N.S. Wales: Mummulgum, Dec. (No. 61); Mosman, Dec. (No. 35); Narrabeen, Jan.; Neutral Bay, Mar. (No. 54).

Badhamia capsulifera, Berk.—Spores spherical, somewhat triangular, finely rough, with a cap of stronger warts, 10·5 μ. Orange, N.S. Wales, Oct., 1916 (No. 14). Not recorded before for Australia.

B. foliicola, List.—Bright orange yellow when immature, turning dark grey. On grass, twigs, etc., Mount Lofty, S.A., June, 1920. Spores purplish, slightly rough, subspherical, 10 to 10·7 μ. "Very near *B. utricularis*, but with spores paler, smoother, and very little if at all clustered. The plasmodium also feeds on decayed leaves, not on living fungi. New for Australia" (No. 28).

Physarum viride, Pers. Milson Island, Hawkesbury River, Nov., 1914, sulphur-yellow, spores spherical, finely warted, dark purplish, 7·8 to 8·2 μ (No. 57).

P. didermoides, Rost.—Wollongbar, N.S. Wales. (No. 13.) New for Australia.

P. nutans, Pers.—Neutral Bay, Sydney, Mar., 1919 (No. 6).

P. compressum, A. and S.—Spores subspherical, warty, purplish, 10·4 to 15·5 μ. Middle Head, Sydney, Aug. (No. 15). "I have no record of this before for New South Wales, though it has been found in South Australia."

P. reniforme, List.—Wollongbar, N.S. Wales (No. 13); on mulberry, Milson Island, Hawkesbury River, June, 1913, spores 13 to 15 μ, very dark, with patches of clustered warts (No. 388). New for Australia.

P. cinereum, Pers.—Milson Island, April, 1913 (No. 22). "A handsome gathering on a Eucalypt leaf; the first record for Australia, apparently."

Fuligo septica, Gmel.—Spores vinous purple, usually smooth, spherical, 7 to 10 μ. Queensland: Imbil, near Gympie, Aug., 1920 (No. 103). N.S. Wales: Milson Island, Hawkesbury River, April, 1913 (No. 23), bright canary-yellow; same location, Feb., 1915, (No. 73), and Nov., 1914 (No. 86); Hawkesbury River, Nov., 1914 (No. 85); on stump of tree, The Spit, Sydney, April, 1913 (No. 71); Neutral Bay, Sydney, Nov., 1917 (No. 24), bright orange-yellow, becoming salmony-red when bruised, several inches long and wide and ¼ inch high, with a peculiar rather seminal smell; on *Fomes* on a log, Tuggerah, Nov.,

1914 (No. 49); at base of an *Acacia*, Kendall (?), Feb., 1917 (No. 21); Narrabeen, April, 1916 (No. 79), canary-yellow. Tasmania: Flinders Island, Bass Straits, Nov., 1912 (No. 70). South Australia: On dead pine stump, Beaumont, Mar., 1920 (No. 65), more lemon-coloured than crocus; on dead pine stump, Glen Osmond, Dec., 1920 (No. 102); Kuitpo, Mar., 1915; National Park, May, 1921; Myponga, Dec., 1923; loc. (?), Mr. Zietz. Western Australia: Loc. not stated (No. 26).

F. septica, var. *candida*, Fr.—N.S. Wales: Milson Island, Jan. (No. 74); Broken Hill, on grass, April, 1917 (No. 16). Tasmania: Flinders Island, at roots of grasses in damp soil (No. 67), typical pale spores, 6 to 7 μ diam. Western Australia (No. 25).

F. cinerea, Morg.—N.S. Wales: Milson Island, April, 1913 (No. 19A); on dung, Neutral Bay, Mar., 1914 (No. 34), spores spherical, 10 to 11 μ. South Australia: Beaumont, on ground, Mar., 1921 (No. 93), spores rough, 11 to 12 μ.

Diachea leucopoda, Rost.—N.S. Wales: Neutral Bay, Dec., 1917 (No. 27), spores smooth, vinous, 8 μ, apparently new for N.S. Wales.

Didymium nigripes, Fr., near var. *xanthopus*, List.—N.S. Wales: National Park, May, 1919 (No. 2), spores dark greyish-brown, smooth, round, 8·5 μ; intermediate between the type and the variety which was found by Mr. Cheeseman several times in N.S. Wales, Victoria, and South Australia.

Mucilago spongiosa, Morg., var. *solida*, List.—Queensland: Imbil State Forest near Gympie, spores finely rough, 12 μ (No. 100). "This is a weak form with the capillitium consisting of membranous expansions enclosing crystalloid deposits of 'lime' instead of the usual network of dark threads. Not recorded previously for Australia."

Stemonitis splendens, Rost.—N.S. Wales: North Bridge, Sydney, April, 1919 (No. 1), spores brown, smooth, spherical, 7·5 μ; Narrabeen (Dr. Darnell-Smith), Nov., 1912 (No. 11), spores warted, purple-brown, 7 to 7·2 μ. South Australia: Glen Osmond, May, 1920 (No. 89), spores purple, smooth, spherical, 7·2 μ. Tasmania: Flinders Island (No. 8). Loc. (?) (No. 19), "with so broad a surface net to the capillitium as to be almost var. *Webberi*, List."

S. herbatica, Peck.—N.S. Wales: Neutral Bay, Mar., 1914 (No. 5); Mosman, Oct., 1916 (No. 69).

Comatricha typhoides, Rost.—N.S. Wales: Neutral Bay, Mar., 1914 (No. 5).

Tubifera ferruginosa, Gmel.—N.S. Wales: On trunk, Neutral Bay, June, 1913, immature (No. 56). Tasmania: Launceston, Nov., 1912 (No. 46), growing through cracks in a log, nearly resembling in colour *Polystictus cinnabarinus* in an early stage but soft, spores spherical, 7 to 11 μ.

Dictydiaethalium plumbeum, Rost.—South Australia: Mount Lofty, Sept., 1920 (No. 101), dried when immature, when fresh rather a coral-pink turning Carnelian Red (Ridgway's Colour Standards, pl. xiv.), surface finely granular; Mount Lofty, June, 1917, and National Park, June, 1917 (No. 30), immature; Mount Lofty, June, 1920 (No. 62), immature, Light Coral-Red (Ridg., pl. xiii.), finely warted under a lens.

Reticularia Lycoperdon, Bull.—N.S. Wales: Neutral Bay, Sydney (No. 84); same locality, May, 1913 (No. 87), on a tree, spores irregularly spherical, warted, 7 to 11 μ. N.S. Wales (?): (No. 92), spores regularly spinulose, spherical to oval, 6·8 μ. South Australia: Beaumont, Mar., 1920 (No. 64), spores brown, spherical, very slightly rough, 7·2 μ.

Lycogala epidendrum, Fr.—Aethalium at first pallid brown with minute topaz warts, spores spinulose, 5·2 to 7 μ. N.S. Wales: Hawkesbury River, Dec., 1914 (No. 37); Athol Gardens, Sydney (No. 68); Comboyne, Sept., 1918 (Nos. 29

and 32); Mount Irvine (Dr. Darnell-Smith), Jan., 1915 (No. 36); Mosman, Oct., 1916.

Trichia verrucosa, Berk.—N.S. Wales: Kurrajong Heights, Aug., 1912 (No. 78); locality not stated (No. 76), spores 17 μ.

T. varia, Pers.—N.S. Wales: Leura, June, 1916 (No. 60), spores finely warted, 13 to 14 x 9 μ.

T. floriformis, (Schw.) G. Lister (syn. *T. Botrytis*, var. *lateritia*, List.—N.S. Wales: Neutral Bay, Mar., 1914 (No. 5); Katoomba, Dec., 1916 (No. 4).

Arcyria ferruginea, Sant.—N.S. Wales: On bark, Neutral Bay, May, 1913 (No. 82), spores colourless, elliptical, 11 to 12 x 8 to 9 μ.

A. cinerea, Pers.—N.S. Wales: Narrabeen, Jan., 1915 (No. 53), very immature, spores colourless, rather oval, capillitium warted.

A. denudata, (L.) Wettstein.—N.S. Wales: Mount Kembla (Dr. Darnell-Smith), Nov., 1914 (No. 83), spores colourless, smooth, 7·5 μ, capillitium branching, rough with warts, 3·4 μ thick; Leura, June, 1916 (No. 10), spores pallid, smooth, 8 μ, capillitium warted, 4 μ thick; no locality (No. 81), spores whitish, irregularly spherical, 7 μ.

A. insignis, Kalchbr. and Cooke.—Probably N.S. Wales (No. 51), "rare in Europe."

A. nutans, Grev.—N.S. Wales: Neutral Bay, Mar., 1919 (No. 7); no locality (No. 80).

Perichaena depressa, Lib.—N.S. Wales: Hawkesbury River (No. 41), yellow, rounded, finely echinulate spores, 10 μ, "new to N.S. Wales, found by Mr. Cheeseman in Victoria."

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY: CENTRAL AUSTRALIA.

No. 1.—INTRODUCTION: DESCRIPTIVE AND ANTHROPOMETRIC OBSERVATIONS.

By T. D. Campbell D.D.Sc., and Cecil J. Hackett.

[Read April 14, 1927.]

The Adelaide University Field Expedition to Central Australia in the early part of this year for anthropological research was made possible by an allocation from the Rockefeller Fund and a private donation. The Anthropological Committee of the Australian National Research Council allotted a sum for field work in physical anthropology in this State and Central Australia. Also through the generosity of Mr. E. W. Holden, B.Sc., it was possible to engage the services of a professional photographer, and so secure some cinematographic, as well as ordinary photographic records.

The success of the Expedition was in no small measure due to the hearty co-operation obtained from various interested helpers; the Board for Anthropological Research and members of the party are much indebted to the following for their very generous assistance:—

Mr. Ernest Kempe (manager Macumba Station); Messrs. Wallis Fogarty and Staff; Sergeant R. Stott and Mr. E. Kramer, of Stuart Town; the Board of Governors S.A. Museum; Dr. L. Keith Ward; and Mr. Blyth (manager S.A. Phonograph Coy.).

In arranging for the work of the Expedition advantage was taken of benefits derivable from "team work" organisation. The work undertaken was largely physical anthropology, and the following constituted the personnel for this section of the work:—Drs. T. D. Campbell and C. J. Hackett, descriptive and anthropometric observations; Dr. W. Ray, physiology and pathology; Prof. J. B. Cleland, blood grouping and tests; Dr. E. H. Davies undertook a study of native songs and music; and Mr. F. Jeffrey acted as official photographer and cinematographer.

The party left Adelaide on December 30, 1926, and returned on January 19, 1927. The localities at which observations were made were:—(1) Ross Waterhole, on Macumba Station, and about 40 miles north-east of Oodnadatta; (2) Stuart Town, Central Australia.

On the first stage of the trip—spent at Ross Waterhole—routine observations were made on a number of natives; also cinema films were exposed on various ceremonies associated with the Lartna, or circumcision rite—the initiation of a youth having synchronized with our visit to the locality.

Through the kindness of Mr. and Mrs. E. Kempe, the arrangements for our stay and work at Ross Waterhole were greatly facilitated, and valued results were secured.

The latter part of the available time was spent at Stuart Town, Alice Springs, where a plentiful supply of full-blooded natives was available for routine work. In this location, through the kindness of Sergeant Stott, the school-room served as a field laboratory, and so working conditions were made comparatively comfortable. Both localities have been occupied for a long time by natives chiefly of the Arunta tribe, and the ethnography of this group has been lengthily dealt with by Spencer and Gillen, Strehlow, and others.

The present paper deals with descriptive notes and measurements of the natives; also certain useful individual details are included. The results of other branches of the work undertaken will be dealt with in other papers of this series. In order that correlative study may be made, the other records are "Physiological Observations," by Dr. W. Ray; "Blood Grouping," by Dr. J. B. Cleland; and "Aboriginal Songs," by Dr. E. H. Davies. These follow in the present issue.

Other papers are likely to be published at an early date dealing with Pathological Observations, Platycnemia, Dental Notes, and Oral Pigmentation.

Full face and profile photographs were taken of each native examined in detail, and besides these, various interesting conditions and views of the natives were recorded.

Motion pictures were taken of various ceremonies concerned in the Lartna, or circumcision rite, also other important features associated with the performances. Native crafts such as firemaking (two methods), string making from human hair, shelter building, and other items were recorded in detail cinematographically. An unusual and interesting motion picture record was also secured on a length of film depicting the striking method of locomotion involved in an extreme case of platycnemia.

A few objects of ethnological interest were collected. A quantity of chipped flakes was obtained at Ooraminna Waterhole. Insects, plants, and ornithological notes were taken *en route*.

Natives Examined.

Tribal classification.—The aboriginals subjected to detailed examination were nearly all members of the Arunta tribe, the remainder being chiefly Luritchas. They were all more or less semi-civilized, a condition which is advantageous, rather than undesirable, when the acquiescence and understanding of the subject under examination are somewhat necessary factors in the type of investigation undertaken on this occasion.

With a few intentional exceptions, all examined were full bloods (in so far as careful discrimination could effect) and adults.

Number.—A total of 57 were subjected to routine detailed examination, while, in addition, various others were dealt with for some special purpose, such as a blood test, or recording some abnormal or pathological feature.

Sex.—Of the above total 44 were males and 13 females.

Age.—The ages given are, of course, in most instances only approximate, but care was taken to secure all evidence which might lead to a correct estimate.

Personal details.—In Table I., given below, are set out various details of each individual, and the key number will serve for identification in the various sections of this and associated papers.

Descriptive Observations.

Descriptive notes were made on each subject and are set out in Table II. In these observations we have followed, to a large extent, the suggestions of Hrdlicka (1).

Skin colour.—For conveniently recording skin colour a shade guide devised by the present writers was used. It consisted of small cards, each having a coloured disc on a neutral grey ground. Adjacent to each disc, a circular hole of similar diameter was made in the card. By placing the card over the skin to be examined, a circular patch of skin can be compared with the coloured disc. Many colour tones were made, and each card being numbered, the skin colour can be simply recorded. These shades were later compared with those of Ridgway (2), and thus a standard nomenclature applied to the colour recorded. Thanks are due to Mr. L. Howie, Director S.A. School of Arts and Crafts, for his assistance in determining the nomenclature for the colours of the guide.

TABLE I.

Subjects Examined.

Key	Sex	Age	White Name	Native Name	Tribe	Group	Totem
1	M	55	Sandy	Winyooli	Arunta	Panunga	—
2	M	30	Macumba Jack	Jakarra	Kaitish	—	—
4	M	aged	Charlie	Mareltna	Luritcha	—	—
5	M	60	John	Deneriga	Arunta	.	Emu
6	M	40	Big Mick	Wilbilli	Urabunna	—	Goanna
10	M	35	George	Kutakulla	Luritcha	—	Emu
11	M	35	Louis	Kuliakulia	Arunta	Panunga	Emu
12	M	...	Billie Johnson	Akareepa	Arunta	Bulthara	Dingo
15	F	—	Judy	—	Arunta	. .	—
16	M	35	Ted	Ortda	Arunta	Kumara	Rain
17	M	55	Tim	Chimpaliga	Arunta	Kumara	Rain
18	M	55	Joe	Murrunyuli	Arunta	Kumara	Rain
19	F	40	Dolly	Aringjilyika	Arunta	Kumara	Rain
21	F	35	Annie	Angkilya	Arunta	Panunga	Snake
22	F	18	Fanny	Angiyoorupu	Luritcha	Bulthara	Snake
23	F	25	Lottie	Unroba	Luritcha	—	—
24	M	25	Dinny	Botalyi	Kaitish	Panunga	Emu
25	M	55	Jack	Ankarra	Arunta	Purula	Kangaroo
26	M	50	Mick	Quorra	Arunta	Bulthara	Rat
27	M	40	Sambo	Lanya	Arunta	Purula	Rain
28	M	25	Ted	Wongarra	Arunta	Panunga	Corkwood
29	M	60	Blind George	Yearamba	Arunta	Bulthara	—
30	M	48	Charlie	Orra-orra	Arunta	Appungerta	Corkwood
31	M	50	Old Bill	Andunna	Arunta	Bulthara	Corkwood
32	M	25	Johnnie	Illowia	Arunta	Ungalla	Kangaroo
33	M	25	Jockey Jim	Orranga	Arunta	Purula	Euro
34	M	30	Jacky	Ubalyamma	Arunta	Kumara	Witchetty grub
35	M	55	Bob	Angtjarra	Arunta	Umbitchana	
36	M	50	Charlie Cooper	Erkakura	Arunta		Yalta (a small plant)
37	M	45	Frank	Karra-indana	Arunta	Umbitchana	Emu
38	M	30	George	Kunanya	Arunta	Ungalla	Corkwood
39	M	60	Bird Jack	Ungotarrinyi	Arunta	Umbitchana	Witchetty grub
40	M	18	Toby	Yarma	Luritcha	—	
41	M	35	Jack	Modna	Arunta	Kumara	Witchetty grub
42	M	16	Bumbi	Ortoo	Arunta	Bulthara?	—
43	M	20	Ralph	—	Arunta	Ungalla?	—
44	M	25	Muller	—	Arunta	Kumara	Emu
45	M	18	Willie	Balyunk	Arunta	Bulthara	Witchetty grub
46	M	55	Jack McKay	—	Arunta	Appungerta	Euro
47	M	60	Peter	Olterberga	Arunta	Umbitchana	Kangaroo
48	M	25	Barney	—	Arunta	Bulthara	Yalta
49	M	60	Multa	Ooabiti	Arunta	Umbitchana	Yam
50	M	50	Bob		—	—	—
51	M	65	Charlie	Jenia	Arunta	Bulthara	Wallaby
52	M	24	Peter		Nelpara	Appungerta	Wallaby
53	M	50	George		Arunta	Purula	Teatree
54	M	26	Dudley	Jawarta	Arunta	Ungalla	Witchetty grub
55	M	27	Arthur	Olbalyoroo	Arunta	Kumara	Witchetty grub
56	M	50	Waggon Jack	Ayumba	Arunta	Umbitchana	—
57	F	40	Annie	Oderquondu	Arunta	Bulthara	—
58	F	35	Mary	Ngumete	Arunta	Bulthara	Wallaby
59	F	48	Marion	Ngtangaramka	Arunta	Ungalla	Witchetty grub
60	F	50	Polly (old)	Ngingara	Arunta	Purula	Kangaroo
61	F	43	Jinnie	Kunoowi	Arunta	Purula	—
62	F	42	Polly (young)	Wungara	Arunta	Bulthara	Water
63	F	48	Mariam	Olinga	Arunta	Bulthara	
64	F	50	Chickina	Orkatnaka	Arunta	Appungerta	Grub

TABLE II.

HAIR.

No.	Head.		Beard and Moustache.		Chest.		Forearm.	
	Colour.	Character.	Colour.	Character.	Colour	Quantity.	Colour.	Quantity.
1	Bl.c.Wh.	L.W.	White	Straight	White	Marked	Bl.c.Wh.	Medium
2	Black	D.W.	Black	L.W.	—	Nil	Black	Medium
4	White	L.W.	White	Straight	White	Scant	White	Scant
5	Grey	Straight	Grey	Straight	White	Scant	Bl.c.Wh.	Scant
6	Bl.c.Wh.	(Cut)	Bl.c.Wh.	Straight	—	Scant	-	Scant
10	Black	L.W.	Black	(Cut)	Black	Medium	Black	Medium
11	Bl.c.Wh.	L.W.	Grey	L.W.	Bl.c.Wh.	Medium	Black	Medium
12	Bl.c.Wh.	(Cut)	Bl.c.Wh.	L.W.	Bl.c.Wh.	Medium	Black	Medium
16	Bl.c.Wh.	M.W.	Grey	Frizzy	Bl.c.Wh.	Scant	Bl.c.Wh.	Marked
17	Bl.c.Wh.	D.W.	Grey	Straight	Bl.c.Wh.	Scant	Bl.c.Wh.	Scant
18	Bl.c.Wh.	Curly	Bl.c.Wh.	L.W.	Bl.c.Wh.	Marked	Bl.c.Wh.	Marked
19	Bl.c.Wh.	L.W.	-	—	—	-	—	V. scant
21	Br. Bl.	L.W.	—	—	—	—	-	V. scant
22	Br. Bl.	L.W.	—	—	-	Nil	—	V. scant
24	Black	L.W.	Black	(Cut)	Black	Scant	Black	Medium
25	Grey	(Cut)	Wh.c.Bl.	(Cut)	Bl.c.Wh.	Medium	Black	Medium
26	Bl.c.Wh.	D.W.	Bl.c.Wh.	M. copious	Bl.c.Wh.	Medium	Black	Medium
27	Bl.c.Wh.	L.W.	Bl.c.Wh.	M. copious	Bl.c.Wh.	Marked	Black	Marked
28	—	L.W.	Black	M. copious	Black	V. scant	Black	Medium
29	White	M.W.	White	Straight	Black	V. scant	Black	Medium
30	Grey	D.W.	Grey	M.W.	Black	Scant	Black	Marked
31	Black	D.W.	Bl.c.Wh.	L.W.	Bl.c.Wh.	Marked	Black	Medium
32	Br. Bl.	(Cut)	Black	(Cut)	Black	Medium	Black	Marked
33	Br. Bl.	(Cut)	—	(Cut)	Black	Scant	Black	Scant
34	Black	D.W.	Black	(Cut)	Black	Medium	Black	Marked
35	Grey	D.W.	White	L.W.	White	Medium	Black	Medium
36	Br. Bl.c.Wh.	M.W.	Bl.c.Wh.	Straight	Bl.c.Wh.	Medium	Black	Medium
37	Black	(Cut)	Bl.c.Wh.	Frizzy	Black	Medium	Black	Scant
38	Br. Bl.	(Cut)	Br. Bl.	M. copious	Black	Marked	Black	Marked
39	White	M.W.	White	L.W.	White	Marked	White	Scant
40	Dk. Br.	D.W.	Black	Scant	-	V. Scant	—	V. scant
41	Br. Bl.	L.W.	Bl.c.Wh.	(Cut)	White	Scant	Black	Medium
42	Br. Bl.	M.W.	Black	Scant	Black	V. scant	Br. Bl.	Scant
43	V. Dk. Br.	L.W.	—	(Cut)	Black	V. scant	Black	Scant
44	Dk. Br.	L.W.	—	(Cut)	Black	Medium	Dk. Br.	Scant
45		L.W.	Br. Bl.	Scant	—	Nil	Dk. Br.	V. scant
46	Grey	D.W.	Grey	Straight	-	Nil	—	Nil
47	Grey	D.W.	White	Straight	White	V. scant	White	V. scant
48	Br. Bl.	L.W.	—	(Cut)	Black	V. scant	Dk. Br.	Scant
49	Grey	L.W.	White	L.W.	White	Scant	Black	Scant
50	Bl.c.Wh.	Curly	Grey	Frizzy	Bl.c.Wh.	Medium	Bl.c.Wh.	Medium
51	White	L.W.	White	Straight	White	V. scant	White	V. scant
52	Black	Curly	Black	(Cut)	Black	V. scant	Black	V. scant
53	Grey	M.W.	Grey	Straight	Grey	Marked	Black	Medium
55	Br. Bl.	(Cut)	Black	M. Medium	—	Nil	Black	V. scant
56	Grey	L.W.	Grey	Straight	Bl.c.Wh.	Medium	Black	Medium
57	Dk. Br.	L.W.	—	—	—	—	Black	V. scant
58	Dk. Br.	L.W.	—	—	—	—		—
59	Dk. Br.	(Cut)	—	—	—	—	Black	V. scant
60	Grey	Curly	—	Scant	—	—	Black	V. scant
61	Br. Bl.	D.W.	-	—	—	Nil	-	V. scant
62	Dk. Br.	L.W.	—	—	—	—	-	V. scant
63	Dk. Br.	L.W.	—	—	—	Nil	Black	V. scant
64	Grey	M.W.	White	Sl. Bald	—	Nil	Black	V. scant

Table II.

No.	Eyebrows. Quantity.	Skin Colour. Face.	Skin Colour. Deltoid.	Skin Colour. Biceps.	Body Build.	Nasal Septum.	Scars.
1	Medium	gg	dd	ff	Medium	N.P.	Nil
2	Scant	ff	ee	ee	Muscular	P.	Chest, Abdomen
4	Medium	ff	ee	dd	Lank	P.	Chest
5	Scant	ff	dd	ff	Plump	P.	Chest, back
6	Medium	gg	ee	dd	Muscular	N.P.	Nil
10	Medium	ff	dd	bb	Muscular	N.P.	Chest, abdomen
11	Medium	—	—	.	Plump	N.P.	Nil
12	Scant	ff	dd	dd	Medium	N.P.	Nil
16	Marked	ff	ee	dd	Muscular		Nil
17	Medium	ff	dd	dd	Obese	N.P.	Chest
18	Medium	—	dd	dd	Muscular	N.P.	Deltoid
19	Medium	dd	dd	bb	Medium	P.	Back
21	Medium	dd	dd	bb	Medium	P.	Chest
22	Medium	dd	dd	dd	Plump	N.P.	Chest, abdomen
24	Medium	aa	ff	bb	Medium		—
25	Medium	ff	dd	dd	Muscular		Chest, abd., delt., scapula
26	Medium	ee	bb	dd	Muscular	—	Scapula, abdomen
27	Scant	dd	bb	bb	Plump	P.	Chest, abdomen, scapula
28	Marked	aa	aa	ff	Muscular	—	Chest, abdomen
29	Scant	aa	dd	dd	Plump	—	Chest, deltoid, abdomen
30	Medium	ee	aa	aa	Muscular	—	Chest, L. scapula, abdomen
31	Medium	aa	aa	aa	Medium	P.	Deltoid, back, abdomen
32	Medium	aa	bb	bb	Muscular	N.P.	Chest, abdomen
33	Medium	hh	dd	bb	Muscular	N.P.	Abdomen
34	Scant	aa	dd	bb	Muscular	N.P.	Nil
35	Medium	aa	dd	bb	Plump	P.	Chest, deltoid, back, abd.
36	Medium	aa	aa	aa	Muscular	N.P.	Chest, deltoid, scapula
37	Scant	aa	dd	dd	Medium	N.P.	Deltoid, abdomen
38	Medium	aa	dd	dd	Muscular	N.P.	Abdomen
39	Scant	ff	dd	dd	Medium	P.	Chest, scapula, back, abd.
40	Marked	aa	ff	ee	Muscular	—	L. scapula
41	Medium	ff	ff	dd	Muscular		Chest, delt., L. scap., abd.
42	Marked	aa	aa	ff	Medium	N.P.	Nil
43	Medium	aa	ee	ee	Muscular	—	Nil
44	Medium	hh	ee	dd	Muscular	N.P.	Nil
45	Marked	ee	dd	dd	Muscular	N.P.	Nil
46	Scant	ff	ff	dd	Slim	P.	Chest, deltoid, abdomen
47	Scant	ff	dd	dd	Plump	P.	Chest, L. scapula, abdomen
48	Medium	ff	dd	dd	Medium	N.P.	Nil
49	Scant	ff	dd	dd	Medium	P.	Chest, delt., abd., L. scap.
50	V. scant	aa	ff	ff	Muscular	P.	Chest, delt., abd., L. scap.
51	Scant	hh	aa	aa	Medium	P.	Chest, delt., abd., L. scap.
52	Medium	aa	gg	ff	Muscular	P.	Abdomen, deltoid
53	Medium	aa	dd	dd	Muscular	P.	Chest, delt., abd., L. scap.
55	Medium	aa	dd	dd	Medium	N.P.	L. Deltoid
56	Scant	aa	aa	aa	Muscular	—	Abdomen
57	Medium	dd	dd	dd	Medium	N.P.	Chest, abdomen
58	Medium	ee	dd	dd	Medium	P.	Chest, abdomen
59	Scant	—	—	—	Plump	P.	Deltoid, abdomen
60	Medium	aa	aa	aa	Plump	N.P.	Nil
61	Medium	aa	ee	ee	Plump	N.P.	Chest, deltoid, abdomen
62	Medium	aa	aa	aa	Plump	P.	Nil
63	Scant	aa	aa	aa	Medium	N.P.	Chest, abdomen
64	Medium	dd	aa	aa	Slim	P.	Chest, abdomen

Hair samples.—A collection of fifty samples of hair was obtained, representing the head and other parts of the body. These should provide useful material for detailed work on this subject.

Data recorded.—The majority of the descriptive observations are set out in Table II., the remainder being more conveniently recorded in subsequent paragraphs.

Key to colours recorded.—The skin colours are recorded in Table II. as double letters. It was found very difficult to match exactly the colours of our guide with the browns given in Ridgway, therefore the following small table is provided to make clear the nature of our findings:—

Shade guide.	Ridgway.	Variation from Ridgway.
aa	Vandyke Brown	Darker than standard
bb	Mars Brown	Warmer and lighter than standard
cc	Bister	Warmer and lighter than standard
dd	Warm Sepia	——
ee	Vandyke Brown	Warmer than standard
ff	Light Seal Brown	Warmer and lighter than standard
gg	Bone Brown	Warmer and darker than standard
hh	Vandyke Brown	Warmer and lighter than standard

Abbreviations used in Table II.—The following are used in connection with hair colour:—Bl.=Black; Wh.=White; Bl.c.Wh.=Black with sparse White; Br. Bl.=Brownish-black; Dk. Br.=Dark Brown.

Hair character:—L.W.=low waves; M.W.=medium waves; D.W. =deep waves. "M. copious" denotes beard shaved off, with a copious moustache.

Nasal septem:—P=pierced; N.P.=not pierced.

From Table II. the following conclusions may be arrived at:—

Head hair.—Usually black, with an increase of white hairs with advancing years. Several white-haired old natives were included in the series. The hair character varied generally between low and deep waviness.

Body hair taken generally cannot be considered very marked in quantity, for the remarks under chest, forearm, and eyebrows show that "scant" and "medium" predominate, the "marked" condition being only occasionally recorded.

Skin colour.—Face, "Vandyke Brown" and "Light Seal Brown" predominate; deltoid region, "Warmer Sepia" and "Vandyke Brown" predominate; inner biceps region, "Warm Sepia" predominates.

Body build.—Taking into consideration the quantity of food apparently available to the natives, the state of nutrition was at once noticed. With very few exceptions, most were noted as "plump" or "muscular." Subcutaneous tissue was nearly always sufficient to round off any bony or muscular prominences.

Nasal septum.—Of 43 observations, in 20 cases the nasal septum was pierced. In several instances the lower border of the perforation was broken through.

The following features were also noted:—

Darwinian tubercle.—Out of 53 observations, the tubercle was present in 5 cases and absent in 48.

Ear lobule.—Fifty-three observations showed that the lobule was adherent in 14 instances, and free in 39.

Supraorbital ridges.—These were fairly consistently "pronounced" excepting: —"Medium," Nos. 1, 5, 6, 11, 12, 19, 21, 22, 28, 38, 41, 45, 47; "very pronounced," Nos. 44, 52, 55, 60.

Lip protrusion.—"Pronounced" in 44 cases; "very pronounced" in 6, and "medium" in 4.

Breasts.—In all the females the form of the breasts was full and pendulous.

Hand.—In all cases the "longest digit" was the third; the "second longest digit" was the fourth in 32 cases, the second in 5 cases; in 11 the second equalled the fourth.

Foot.—The "longest digit" in 30 instances was the first, in 20 the second, in one case the first equalled the second.

Eye colour.—In the younger subjects the iris colour was a light chocolate-brown, but appeared to become much darker with advancing age. The colour was frequently obscured by corneal opacities. The conjunctiva in the young subject is bluish-white, but became yellowish in the adult and a dirty yellow colour with approaching senility.

Anthropometry.

Measurements adopted.—The measurements used on this occasion are in accordance with the suggestions of the International Agreement (see Hrdlicka), and the set chosen is almost identical with the series used on previous occasions by one of the present writers as collaborator with F. Wood Jones (3) and A. J. Lewis (4). Those adopted in the present record are given in Table III.

Instruments used.—Martin's stature rod, spreading and sliding calipers, and a non-metallic tape. For the loan of most of these instruments we are indebted to the Board of Governors, S.A. Museum.

Data recorded.—The results of this section of the work have been set out in Tables IV. and V. The mean values of each observation are given at the bottom of the columns.

Comparative notes.—The following lists will show a comparison between the results of the present work and the figures published by Wood Jones and Campbell, and Campbell and Lewis. Only a few of the more important measurements are tabulated.

Table III.

Body	A .. Stature		Head	BB .. Breadth	
	B .. Sitting height			CC .. Height	
	C .. Height to supra sternal notch		Face	DD .. Height meuton crinion	
	D .. Shoulder height			EE .. Height meuton nasion	
	E .. Shoulder breadth			FF .. Diameter minimum frontal	
	F .. Arm span			GG .. Diameter bizygomatic	
Arm	G .. Total length arm			HH .. Diameter bigonial	
	H .. Length upper arm			II .. Maximum interorbital	
	I .. Length lower arm			JJ .. Maximum intercanthal	
Hand	J .. Length			KK .. Minimum intercanthal	
	K .. Breadth			LL .. Bi-orbito nasal arc	
Leg	L .. Total length leg		Nose	MM .. Length	
	M .. Length upper leg			NN .. Height	
	N .. Length lower leg			OO .. Breadth	
Foot	O .. Length		Mouth	PP .. Breadth	
	P .. Breadth			QQ .. Height	
Head	AA .. Length		Ear	RR .. Length	
				SS .. Breadth	

Observation.	Wood Jones and Campbell.		Campbell and Lewis.		Campbell and Hackett.	
	Number.	Mean.	Number.	Mean.	Number.	Mean.
Stature ..	.. 309	1636	25	1593	56	1630
Head length	.. 173	187·9	25	187	56	189·6
Head breadth	.. 173	137·6	25	135	56	142
Nose height	.. 10	44·6	25	43·2	57	52·1
Nose breadth	.. 10	46·3	25	44·8	57	48·6

It will be seen from these figures that the natives in the regions of the present enquiry give (a) a mean stature close to the other records; (b) closely similar head length, but relatively greater breadth; (c) mean nasal measurements which show a larger nose than that indicated by the other records, this probably being due to the marked numerical preponderance of males over females in the present data.

Indices.—A number of the more important indices have been derived from the figures obtained. They are set out in the table given below, and for comparison the results of the two papers referred to above are also included.

Index.	Wood Jones and Campbell.		Campbell and Lewis.		Campbell and Hackett.	
	Number.	Mean.	Number.	Mean.	Number.	Mean.
Cephalic ..	81	73·3	25	72·2	56	74·7
Facial ..	51	86	25	81·7	57	81·3
Nasal ..	81	100·7	25	104·6	57	93
Ear ..	50	56·6	25	53·1	57	52·7
Radio-humeral	10	81·4	25	81·5	57	75·8
Tibio-femoral ..	10	95·9	—	—	57	89·4

From these results it will be seen that the natives of the present enquiry come under the following classifications:—

Head	Dolichocephalic
Face	B:L 81·3%
Nose	Platyrhinic
Ear	B:L 52·7%
Ratio lower to upper arm ..	Mesatikerkik
Ratio lower to upper leg ..	Dolichocnemic

Taking the present figures and those of Campbell and Lewis in the above table, two definite regions are represented, namely, Central Australia and an area north of Ooldea on the Trans-Australian Railway. The indices for Central Australia show a relatively broader head, similar breadth of face, narrower nose, similar ratio for ear dimensions, and a relatively shorter forearm. The figures given by Wood Jones and Campbell represent a compilation of all the available data from various localities up to the time of publication.

Summarized data.—By combining the data given for three investigations, we may derive some appreciable estimation of certain physical characteristics as indicated by their index values; that is, based on data which have been recorded in a manner at all conformable with standardized requirements.

Feature.	Number of Observations.	Mean of Indices.	
Head	162	73·6	Dolichocephalic
Face	133	83·1	
Nose	163	98·6	Platyrhinic
Ear	132	54·2	
Radius: humerus ..	92	77·8	Mesatikerkik
Tibia: femur ..	67	90·3	Dolichocnemic

General Summary.

In investigations of this nature, the ultimate aim should be, we believe, to arrive eventually at some clearly-cut account which tells just what a typical Australian native looks like: this, rather than express his physical features in abstruse biometric formulae, or, on the other hand, to describe him in long

Table IV.

Body and Limbs.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	1578	779	1298	1317	354	1660	739	322	222	178	85	847	410	382	246	97
2	1674	829	1405	1402	393	1834	794	314	253	202	89	948	458	427	259	98
4	1673	760	1399	1413	386	1790	818	348	273	192	84	946	462	430	273	97
5	1597	820	1336	1322	354	1686	750	330	232	188	91	873	427	378	258	102
6	1733	818	1424	1424	392	1846	772	353	233	198	93	978	501	422	261	104
10	1671	868	1386	1413	384	1921	794	345	251	193	93	906	474	365	273	105
11	1651	850	1357	1360	375	1750	745	316	241	185	91	894	444	379	242	91
12	1731	820	1441	1436	368	1885	842	361	273	200	92	988	408	404	272	99
15	1487	752	1230	1223	317	1532	659	284	209	161	71	820	386	372	222	88
16	—	—	1379	1400	371	1849	815	340	253	207	92	922	434	429	286	102
17	1616	782	1348	1339	390	1762	751	308	253	189	92	919	456	399	264	105
18	1591	811	1317	1321	323	1657	771	300	233	180	86	866	433	377	239	93
19	1561	791	1288	1334	328	1440	721	313	233	166	76	830	413	376	242	89
21	1459	793	1289	1289	316	1568	697	300	226	165	76	816	377	380	217	84
22	1561	778	1311	1322	314	1594	678	300	210	169	78	846	431	357	238	90
23	1563	775	1303	1297	328	1670	745	300	265	170	76	879	453	367	236	92
24	1830	891	1537	1542	369	1973	876	367	337	201	89	1030	510	457	280	97
25	1686	811	1419	1421	371	1839	809	347	279	195	91	954	455	429	270	100
26	1611	840	1324	1317	368	1738	751	317	237	197	91	860	459	338	255	112
27	1707	832	1458	1424	377	1853	805	353	259	191	90	1013	506	426	269	109
28	1639	805	1366	1382	354	1738	766	342	238	185	87	903	418	418	258	100
29	1602	854	1320	1333	331	1628	690	306	236	175	84	839	403	367	244	95
30	1616	815	1326	1323	374	1757	738	311	237	191	89	883	483	339	256	94
31	1538	739	1287	1260	312	1629	759	324	251	182	80	853	413	377	238	91
32	1657	846	1361	1344	369	1754	745	316	238	184	89	860	425	363	260	105
33	1578	812	1312	1304	339	1644	725	313	232	175	82	852	411	379	228	92
34	1663	831	1366	1380	362	1787	778	332	253	188	91	913	465	376	266	103
35	1562	763	1296	1323	350	1658	755	319	250	178	87	876	435	378	246	95
36	1594	793	1333	1305	345	1702	756	327	226	198	87	884	441	375	255	99
37	1611	807	1330	1317	345	1709	753	314	251	189	83	868	397	398	255	103
38	1613	812	1343	1328	350	1712	748	308	251	192	85	885	433	384	245	94
39	1582	746	1317	1318	341	1703	735	306	219	177	82	905	433	393	247	94
40	1661	822	1384	1371	366	1799	792	339	253	192	88	911	430	414	256	101
41	1738	849	1476	1456	381	1872	840	356	267	197	89	956	448	434	278	100
42	1703	819	1423	1417	351	1803	809	345	269	192	88	958	461	431	259	102
43	1787	895	1504	1480	400	1946	869	365	281	209	101	975	480	421	282	108
44	1726	879	1428	1419	376	1851	818	350	267	198	92	905	437	417	266	101
45	1684	834	1418	1408	374	1818	786	328	258	193	89	938	465	391	268	100
46	1704	854	1424	1425	350	1799	780	334	259	197	82	923	447	414	258	98
47	1661	815	1393	1403	330	1771	775	337	247	184	92	916	455	388	245	99
48	1650	822	1379	1370	349	1775	792	341	250	195	87	904	442	394	245	95
49	1659	806	1395	1406	334	1742	773	326	256	185	81	931	454	407	258	96
50	1627	823	1373	1354	349	1760	766	320	242	193	88	887	425	383	269	99
51	1666	775	1387	1408	335	1799	840	349	284	197	89	960	453	446	262	100
52	1672	823	1401	1375	358	1773	783	342	259	178	83	910	418	393	256	88
53	1646	787	1369	1374	324	1786	794	330	254	193	94	990	488	420	269	102
54	1656	822	1368	1372	368	1760	792	332	254	192	90	923	455	403	263	105
55	1662	852	1386	1400	341	—	762	328	250	177	86	924	458	405	259	89
56	1689	861	1393	1394	355	1783	789	316	265	198	90	917	429	412	262	109
57	1537	763	1278	1292	314	1613	695	317	197	173	76	852	409	382	234	89
58	1560	763	1299	1299	311	1644	727	315	221	171	77	862	411	393	225	83
59	1559	810	1311	1314	324	1567	698	280	231	177	82	823	394	368	265	89
60	1562	755	1313	1313	327	1627	749	314	240	176	78	862	414	393	234	79
61	1609	763	1371	1368	328	1716	752	304	256	181	79	903	428	394	241	99
62	1475	739	1227	1219	301	1504	666	286	211	167	73	798	372	364	228	82
63	1564	740	1316	1305	314	1614	711	309	213	174	75	869	410	403	237	89
64	1589	761	1337	1345	300	1619	719	311	246	180	77	876	433	387	240	88
Mean	1630.1	806.3	1362.5	1359.8	349.2	1736.5	766.3	325.6	247.0	186.6	85.6	902.6	438.8	394.5	253.8	96.9

Table V.

Head.

	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	RR	SS
1	188	138	128	185	112	97	138	102	117	87	30	105	55	55	59	57	18	79	40
2	194	146	134	181	106	100	136	99	112	91	30	130	52	48	47	59	14	62	36
4	209	148	125	192	115	114	145	108	116	102	41	140	56	54	63	76	11	74	39
5	199	142	135	178	116	97	134	107	111	85	31	130	56	53	51	53	12	69	39
6	199	144	129	163	115	113	137	106	115	93	39	140	59	53	48	68	16	69	39
10	195	146	123	200	131	104	143	111	122	101	37	140	54	57	53	64	21	72	38
11	202	147	134	181	113	107	137	106	110	87	35	130	51	51	44	58	17	64	33
12	203	143	131	192	117	101	143	95	121	98	31	130	54	55	50	62	10	72	36
15	187	143	128	169	113	101	127	89	104	84	34	125	49	52	44	55	31	63	36
16	191	—	—	184	109	107	147	101	125	103	33	130	59	59	51	59	13	76	36
17	196	139	131	191	116	99	143	113	115	95	33	130	56	53	58	58	13	69	39
18	185	142	133	197	124	101	133	96	109	91	33	120	54	57	47	62	19	64	34
19	183	138	122	165	102	101	131	94	131	81	29	115	50	49	39	55	14	63	31
21	179	142	128	166	105	96	127	93	104	80	32	115	50	50	40	51	13	62	31
22	188	138	121	168	102	101	129	96	108	94	34	120	46	48	46	53	16	62	32
23	181	132	114	169	101	99	125	87	106	84	31	110	50	50	39	50	16	63	33
24	196	145	136	181	114	106	144	91	113	94	29	125	51	53	50	50	18	69	36
25	182	148	118	193	117	96	147	95	117	87	31	120	59	57	49	62	5	67	40
26	184	142	130	195	123	99	139	96	112	91	35	115	55	55	47	57	16	66	33
27	190	142	127	189	118	94	142	116	112	93	31	125	54	56	53	60	5	65	29
28	195	145	128	191	120	99	145	96	116	97	32	125	57	57	48	61	16	69	38
29	186	145	123	209	122	108	147	102	119	93	35	125	57	58	49	54	15	64	35
30	189	146	121	187	119	100	143	115	116	86	35	115	54	55	45	55	18	58	32
31	187	142	116	204	114	100	143	102	114	95	37	125	57	56	53	66	12	73	33
32	195	148	124	174	108	104	145	117	112	95	34	125	50	48	54	58	14	62	35
33	182	141	125	185	105	93	136	94	112	86	28	117	51	50	46	53	14	64	34
34	192	138	139	191	116	105	139	111	116	91	31	117	56	53	51	63	18	68	34
35	188	141	142	202	110	97	140	99	116	92	34	125	55	53	49	67	14	71	39
36	194	142	131	186	114	105	142	97	114	90	35	120	53	55	48	62	14	70	35
37	186	151	126	206	117	106	144	100	113	92	36	120	57	54	54	64	8	72	34
38	187	133	109	179	113	92	135	96	112	91	31	120	55	56	50	62	10	62	31
39	185	138	111	190	116	97	145	103	114	89	32	115	53	55	57	70	17	70	34
40	195	143	124	197	113	100	127	93	111	95	34	120	52	54	49	57	21	65	36
41	193	145	117	185	107	101	143	104	113	102	33	103	54	54	50	57	16	67	37
42	188	145	123	181	115	108	135	97	111	96	34	120	54	54	45	54	20	66	39
43	203	145	128	198	123	111	140	96	116	98	36	125	50	52	48	57	21	68	37
44	201	135	130	189	118	101	136	109	114	91	30	123	51	51	46	59	10	68	35
45	192	139	128	183	117	106	137	102	114	98	37	125	50	50	47	51	21	62	37
46	188	148	135	175	103	93	140	99	115	86	32	120	53	52	46	60	10	70	40
47	191	141	133	185	112	104	148	102	118	93	34	125	49	49	50	64	11	81	37
48	196	143	133	175	107	106	137	94	108	89	28	110	50	51	45	54	16	67	34
49	190	143	131	215	120	107	141	107	114	90	33	120	55	54	51	64	18	70	36
50	193	147	121	197	106	109	144	113	123	95	32	130	54	53	50	65	19	71	36
51	198	153	133	198	120	105	144	98	115	91	34	120	54	53	53	69	14	79	40
52	192	138	131	175	106	99	142	93	109	88	30	115	46	41	46	58	17	60	31
53	187	133	124	191	103	105	137	100	111	89	31	125	53	51	60	66	25	74	38
54	193	144	119	184	118	107	141	104	117	98	32	125	54	53	47	63	16	64	35
55	191	148	123	181	117	106	147	108	117	93	35	125	50	49	47	57	14	58	36
56	195	143	129	186	116	104	151	104	124	95	35	132	56	55	51	62	11	76	35
57	192	130	113	165	104	95	124	87	104	81	32	115	50	49	42	59	17	59	32
58	184	138	116	167	103	98	131	94	109	85	30	112	47	46	45	58	15	61	33
59	188	137	121	176	111	103	139	105	111	87	31	120	52	51	48	63	17	71	38
60	183	136	114	160	101	96	135	96	111	87	33	115	47	45	52	62	14	74	32
61	192	145	127	171	101	102	132	94	109	87	35	120	49	48	42	63	24	72	36
62	176	140	119	175	115	107	132	89	108	87	34	115	53	51	47	57	13	60	35
63	188	137	115	173	105	99	128	93	105	80	31	112	53	47	44	50	15	65	34
64	173	142	121	172	102	97	129	91	102	75	34	110	45	44	41	57	16	66	32
Mean	190.5	142.1	122.2	184.2	112.2	102.0	138.1	100.0	113.3	91.1	32.9	121.7	52.7	52.1	48.8	57.7	15.5	67.4	35.2

drawn-out descriptive detail, the value of which is often too much distorted by the personal equation.

The data we now have available, based on systematic recording, are, as yet, quite insufficient to constitute anything in the nature of a comprehensive survey; nevertheless, we are gradually attaining a stage when some tentative analysis of the observations on certain physical features may be granted. Without relying too much on mathematical expression or lengthy description, we may safely say that from the data available, the Australian native seems to present fairly consistently the following physical characteristics:—

In stature he is slightly less than the average human height (1675 mm., Haddon).

He is definitely dolichocephalic or long-headed.

He is always platyrhinic, that is "flat-nosed," and generally has a relatively broad face. His supraorbital ridges are pronounced and his lips protrusive.

The character of his scalp hair varies from low to deep waves and is only occasionally curly, and seldom frizzy.

His general bodily hirsuteness is by no means marked, and excessive hairiness seems to occur with no greater frequency than in white persons.

His skin is a dark-brown colour, or more definitely, a vandyke brown, but rarely approaching a real black.

References.

(1) Hrdlicka, A., "Anthropometry," 1920.

(2) Ridgway, R., "Colour Standards and Colour Nomenclature," Washington, 1912.

(3) Wood Jones, F., and Campbell, T. D., Trans. Roy. Soc. S. Austr., vol. xlviii., 1924, pp. 303-12.

(4) Campbell, T. D., and Lewis, A. J., Trans. Roy. Soc. S. Austr., vol. l., 1926, pp. 183-191.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY: CENTRAL AUSTRALIA.

No. 2.—PHYSIOLOGICAL OBSERVATIONS.

By WILLIAM RAY, M.B., B.Sc.

[Read April 14, 1927.]

While physical measurements were being made by members of the University Anthropological Expedition, in January of this year, it was felt that some observations on full-blooded Australian natives from the physiological point of view might be valuable. It was, moreover, felt that such observations might answer the question whether full-blooded natives, in a comparatively native condition, could be brought to submit to more extensive observation requiring aid to the observer on their part, such as the determination of basal metabolic rates.

The observations here made were:—

(1) Blood pressure.
(2) Pulse-rate.
(3) Vital capacity measurements.
(4) Haemoglobin estimations.
(5) Temperature.

(1) The blood pressure was measured by a Tycos instrument with spring pressure gauge on the right arm with the subjects resting quietly. No difficulty was experienced with the natives whatever in obtaining muscular relaxation, nor did any psychic factors enter, judging from the steadiness of the pulse-rates.

The average pressure of the males, 42 in number, was:—

Diastolic ..	.. 79·07	mm. of mercury.
Systolic ..	.. 125·3	mm. of mercury.
Pulse pressure	.. 46·3	mm. of mercury.

Of the females, 13 in number, the pressures were slightly smaller, being:—

Diastolic ..	.. 73·5	mm. of mercury.
Systolic ..	.. 116·0	mm. of mercury.
Pulse pressure	.. 42·5	mm. of mercury.

These pressures almost exactly coincide with the standards given for healthy Europeans, but are distinctly lower than healthy white Australians by 5-10 mm. of mercury.

The highest systolic pressure recorded in the males was 150 mm. The highest diastolic, 90 mm.

The lowest systolic (males) was 105 mm.

The lowest diastolic (males) was 65 mm.

The ratio of the pulse pressure to the diastolic and systolic pressures is what is regarded as theoretically perfect for normal Europeans.

No relationship can be traced in this small number of observations between the blood pressure and height and weight.

(2) The pulse was taken in the sitting posture. The averages were:— Males (48), 84 per minute; females (12), 88 per minute. These are slightly above the European standard.

(3) Vital capacity. It was here that great trouble was experienced, and only a proportion of the natives could manage the required breathing and exhaling through the spirometer. The same difficulty was experienced in measuring the chest expansion. This is in great contrast to the facility with which they can control the movements of the abdominal muscles, their abdominal respiration being extremely complete. The observations recorded are of those natives who "seemed" to understand the manoeuvre required and where several observations upon each native showed that he had reached the limit of his respiratory capacity. The obviously inaccurate measurements have been completely deleted.

The vital capacity, judged on European standards, is low, the maximum effort 3800 cc. in a native weighing 176 lbs.

Dividing them into weight groups the following were the figures:—

	Weight range.	Individuals.	Av. weight.	Av. vital capacity.
(1)	100-120 lbs.	4	113 lbs.	2562 cc.
	121-140 lbs.	6	129 lbs.	2936 cc.
	141-159 lbs.	8	149 lbs.	3382 cc.
	Over 160 lbs.	4	166 lbs.	3425 cc.

The impression was gained that if further metabolic experiments are to be done a strict selection of natives must be made, and the greatest watch kept for "auspumpung" and other disturbing factors.

(4) The haemoglobin estimations were made with a Tallquist Haemoglobinometer, and though this method does not give absolute results, yet they are sufficiently accurate, and we may judge from the figures that the haemoglobin percentage is 100 per cent. when compared with European standards. Out of 41 individuals there are 5 below 90 per cent.

Per cent.	Males.	Females.	Total.
100	26	5	31
95	0	1	1
90	3	1	4
85	2	0	2
80	1	1	2
70	1	0	1
	33	8	41

(5) The temperatures were taken in the mouth and were higher than those of the party by 0·6 of a degree Fahr. The temperature of the room in which the work was done varied from 93°-97° Fahr.

The males showed the same temperature as the females, the respective figures being:—Males (21), 99·4; females (8), 99·5.

The average temperature of the members of our party during the same period was 98·9° Fahr.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY: CENTRAL AUSTRALIA.

No. 3.—BLOOD-GROUPING OF AUSTRALIAN ABORIGINALS AT OODNADATTA AND ALICE SPRINGS.

By J. Burton Cleland, M.D.

[Read April 14, 1927.]

During the recent University Expedition, financed in part by the Rockefeller Foundation through the Australian National Research Council, the blood groups of 57 pure-blooded aboriginals and of 3 half-castes were determined. The pure-blooded aboriginals all belonged to Group II. (27) or Group IV. (30) of Moss' Classification. Of the three half-castes one belonged to each of Groups II., III., and IV., and it is rather interesting to note that the Group III. indivdual had a father who was half a Japanese.

During the trip an estimation of the blood groups had to be undertaken frequently under difficult conditions. The weather almost throughout was intensely hot, ranging usually from about 105° to 111° in the shade. This intense and dry heat caused rapid evaporation of any fluids. Nineteen tests carried out at our camp at Ross' Waterhole, on the Macumba River, near Oodnadatta, had to be done in the open air, and it was sometimes difficult to escape from wind and dust. Forty-one tests carried out at Alice Springs were done under better and more comfortable conditions through the kindness of Sergeant Stott, who placed at our disposal a suitable room.

The method adopted in carrying out the tests consisted in drawing blood from a needle-prick of the pulp of one of the fingers of the left hand and running a small quantity into a narrow tube containing citrated saline. Following on this the finger was dried and further blood collected in a dry, narrow-bored tube in which it was allowed to clot, and the separated serum was then used for testing with citrated red cells of Groups II. and III. In this way the red cells of the aboriginals were obtained for testing against known sera of Groups II. and III., and reversing, the aboriginals' serum was obtained for testing against citrated red cells belonging to known Groups II. and III.

No difficulty whatsoever was experienced in obtaining blood from adult aboriginals, either male or female. They had probably been told at both localities where we carried out the tests that they were to allow us to carry out such examinations as we required, though they were not in any way forced to acquiesce. We explained to them in pigeon English that we wanted to see whether the blackfellow's blood was more like the white man's than that of a Chinaman or an Afghan, and they all assented by nods to our request for obtaining samples of blood. Some jumped when the puncture was made, and one strong young man vomited suddenly and unexpectedly a large quantity of watery fluid apparently as a reflex act. When, however, we desired to obtain blood from the children, these proved so unwilling and frightened that we had entirely to desist.

The results may be briefly tabulated as follows, it being noted that Moss' Classification is adopted, and not that of Jansky. In Jansky's Classification Group I., of Moss, becomes Group IV., and Group IV. becomes Group I.:—

Of 57 pure-blooded aboriginals 27 belonged to Group II. and 30 to Group IV.; 13 of these were women, 7 belonging to Group II. and 6 to Group IV.

16 pure-blooded aboriginals examined on the Macumba River near Oodnadatta showed 8 belonging to Group II. and 8 to Group IV.

3 mixed bloods (a father and 2 sons), all with an intermixture of Japanese, belonged respectively to Groups II., III., and IV.

41 natives tested at Alice Springs showed 19 of Group II. and 22 of Group IV.

The key sera belonging to Groups II. and III. had been prepared before leaving Adelaide from two members of the Expedition, the writer of this article, who belonged to Group II., and Mr. Hackett, who belonged to Group III. The Expedition thus had with it and constantly on tap the blood of individuals known to belong to Groups II. and III. As far as possible it is intended that these two individuals shall be the source of supply of serum and corpuscles during further investigations. As members of the medical profession both will be available, and any anomaly or peculiarity in reaction occurring with white people's bloods and their serum or corpuscles can be noted. It will be seen that certain anomalous results have been met with in testing the aboriginals which will necessitate some further comparative work on white Australians.

Employing key sera II. and III. the issues of all the tests with the aboriginal red cells were clear cut, except on one occasion where a Group II. man gave no agglutination with the Group III. serum owing to the corpuscles being too numerous, but gave agglutination when they were fewer.

To confirm the grouping determined by employing Group II. and Group III. sera, the reverse was attempted, the serum being obtained from the aboriginal and the citrated red cells belonging to Group II. and Group IV. from the two members of the Expedition. This reversing yielded some anomalous results of considerable interest. When using Group II. citrated red cells the positive and negative results were always clear cut, and only once was a positive recorded as rather weak. The agglutination usually occurred more quickly and was more marked and coarser than that with the Group III. reds.

Using the Group III. red cells we found that the agglutination of these by an aboriginal Group IV. serum was recorded in 4 out of the 30 individuals of this group as being "fine and slow," or "rather fine and slow," and once as "rather weak" (in this case the agglutination with the Group II. red cells was also rather weak), and once a negative result was obtained when the red cells were too concentrated, agglutination occurring on repeating with more diluted red cells.

The remaining 24 gave typical agglutination results.

The 27 aboriginals belonging to Group II., which should all have agglutinated the Group III. red cells, gave the following results:—

In 16 the agglutination was definite and no comments were made indicating any departure from what was expected.

In 3 agglutination took place slowly and the clumping was fine.

In one it is called "fine."

In one "rather fine."

In one "very fine, appearing only with much dilution."

In 2 it was "fine and rather slow," and the use of the compound microscope showed only some of the corpuscle clumped.

In one the compound microscope showed the corpuscles mostly clumped.

Once no agglutination occurred, the test being repeated four times with two separate samples of blood.

Once there was no agglutination to the naked eye, but examined with a compound microscope occasional doubtful clumps were seen.

(It may be mentioned here that the compound microscope was only used occasionally in doubtful cases, the issue being usually perfectly clear cut to the naked eye, or, if a little doubtful at first, a hand lens would reveal the presence or absence of agglutination.)

As the result of the examinations made by us on this Expedition it would appear that in our Southern Australian aboriginals the agglutinable substance A characteristic of Group II. is present in nearly half of the individuals examined, the red corpuscles of the other half lacking both agglutinable substances A and B. Now with the presence of the agglutinable substance in the red corpuscles there is the necessary absence from the serum of the corresponding agglutinin. When both agglutinable substances are present in the corpuscles both the corresponding agglutinins are absent. When only one agglutinable substance is present in the corpuscles, the agglutinin corresponding to the other agglutinable substance is present in the serum in the case of most human races. When both agglutinable substances are absent from the corpuscles, both kinds of agglutinins would be expected to be present in the serum. In our Southern Australian aboriginals we found that nearly half contained only the agglutinable substance A characteristic of Group II.; the other half contained no agglutinable substance in their red cells. In the serum of the former we should expect to find the agglutinin A capable of clumping the corpuscles of Group II. individuals, and in the serum of the latter we would expect to find the presence of both agglutinins A and B.

The sera of our Group IV. aboriginals showed characteristically the presence of agglutinin A. The presence of the agglutinin B was also found in all cases, though the amount of this agglutinin seemed sometimes less than the amount of agglutinin A.

The 27 sera of our aboriginals of Group II. should all have contained the agglutinin B for Group III. red cells. In the majority of instances (16) the serum did contain this agglutinin. In 9 cases it was present, but apparently in diminished amount. In one case it was almost entirely absent, and in one case it could not be detected. It is seen, therefore, that in our Southern Australian aboriginals the agglutinin B is present in the serum of Group IV. individuals, but sometimes in somewhat diminished amount, and in the serum of Group II. individuals in an appreciable number of cases it is diminished in amount and occasionally cannot be detected. It is interesting to see here the presence sometimes in the serum of an agglutinin the corresponding agglutinable substance of which has not yet been detected in our Southern Australian aboriginals.

We have now tested 158 full-blooded aboriginals of Central Southern Australia, and these have all belonged to Groups II. and IV. of Moss' Classification, namely, 82 to Group II. and 76 to Group IV.

Summary.

Fifty-seven pure-blooded aboriginals were tested, of whom 27 belonged to Group II. and 30 to Group IV. (Moss' Classification). The sera of all the Group IV. individuals showed the presence of the agglutinin A for Group II. red cells. All of the 57 individuals should have shown the presence of the agglutinin B for Group III. red cells, but this agglutinin was sometimes poorly developed or even absent in Group II. individuals. Of three half-castes with Japanese blood, one was found to belong to Group III. The results obtained support still further the view of the Australian aboriginal being a pure race in whom only Groups II. and IV. (Moss' Classification) occur.

ADELAIDE UNIVERSITY FIELD ANTHROPOLOGY: CENTRAL AUSTRALIA.

No. 4.—ABORIGINAL SONGS.

By E. Harold Davies, Mus.Doc., Elder Professor of Music,
University of Adelaide.

[Read April 14, 1927.]

I.—Introduction.

An investigation into the vocal characteristics, musical susceptibilities, and folk-songs of the natives of a portion of South Australia and the Northern Territory has formed one part of the work of the University Anthropological Expedition, under Dr. T. D. Campbell, which journeyed from Adelaide to Alice Springs (Northern Territory) in December, 1926.

The Expedition—made possible by a special grant of the Rockefeller Foundation—was more in the nature of a preliminary survey, and although the scope of its observations was limited to a comparatively brief period, mainly spent at Macumba River (40 miles N.E. of Oodnadatta) and at Stuart, in the Northern Territory, it served to establish the existence of large and fruitful fields for further investigation. In South Australia and the Northern Territory, more than in any other part of the Commonwealth, it appears that the living subject is still easily accessible, and available for research. Surely, therefore, no opportunity should be lost in the immediate pursuit of this important work.

On the particular matter to be now dealt with, the following tentative observations, though carefully considered, are put forward as a basis only for more detailed and comprehensive study.

And such study, besides securing the fullest possible records of aboriginal songs, might also be extended to the more general questions of phonetics and speech peculiarities.

Hitherto very little appears to have been done along these lines. Sir W. Baldwin Spencer, in various expeditions, has made a number of phonographic records (now lodged in Melbourne Museum). A. W. Howitt in "Native Tribes of South-East Australia" devotes only a few pages of his monumental work to "Songs and Song-Makers," quoting in all three songs, taken down from dictation by the late Dr. Torrance, who also submitted an aboriginal—Berak—to certain auditory muscial tests.

Passing reference to corroboree songs may also be found in such standard books as "Savage Life in Central Australia," Horne and Aiston; "Natives of Australia," N. W. Thomas; "North Queensland Ethnography," by W. E. Roth; and "Aborigines of Victoria," Brough Smyth; while Dr. Herbert Basedow devotes a whole chapter of his "Australian Aboriginal" to the subject of "Music and Dance," discussing certain features in a general way. In none of these works, however, is there any detailed analysis of individual songs, nor any critical estimate of their value in relation to the evolution of the art of music. Even such scientists as the authors of these various treatises are seldom competent to deal with a purely musical investigation; nor, on the other hand, are musicians often disposed to the pursuit of ethnology.

Yet it may be strongly urged that, beyond the mere objective evidence of musical tendencies in a primitive race, there is the deeper subjective interest;

and the question must be constantly asked—if not immediately answered—"Why does the aboriginal do these things?"

II.—The Recording of Songs.

(a) Apparatus used.—In connection with the present Expedition much preliminary time was spent in searching for, and experimenting with, a machine suitable for work in the field under any possible conditions.

Mr. Blyth, Manager of the South Australian Phonograph Company, was able to furnish a second-hand Edison phonograph of the old cylinder type, and with his enthusiastic help this was brought to a point of comparative efficiency. The recording horn was the subject of close attention, and no less than four horns of different shapes and calibre were made, and tried out, before the final choice was reached. This consisted of the bell of a euphonium (a large-sized brass band instrument) which was lengthened by the addition of a tapering cone of block tin to about 2 feet over all. Of all the horns tried, this proved to be the most sensitive acoustically, as well as freest from "blasting," but further experiment may result in considerable improvement of this most important part of the apparatus.(1)

It was also found that the *two-minute* speed of recording was better than the *four-minute* speed, cutting a wider track and giving a greater margin of safety over possible irregularities on the surface of the wax cylinder.

In actual operation this machine gave fair results, though all the recording was done at a temperature of 100 degs. or more in the shade, while dust and grit were a constant hindrance to its smooth working. The intense heat also caused a rapid perishing of the fine rubber gaskets on either side of the diaphragms in the sound boxes used both for recording and reproducing.

It is very necessary that the attention of those who are skilled in the making of apparatus for sound recording purposes should be directed to the production of a simple and reliable instrument for field uses. A portable battery, with a microphone and a long length of flex, might conceivably be devised as an extension for readily securing more delicate sounds, as well as those which cannot be brought into close proximity to the horn of the ordinary phonograph. In any case, simplicity and reliability are absolutely essential.

(b) Recording methods adopted.—In previous attempts at securing aboriginal songs, such as those of Sir Baldwin Spencer, the great majority of the records made consist of the whole body of singers taking part in each song.

From the outset I felt sure that better results might be obtained by selecting an individual singer who could be seated directly in front of the recording horn. The following reasons will make this clear:—

(1) In massed singing of relatively untrained performers, there are always many of inferior ability who mar the general effect of the song. This may be observed even among our own people, where in popular airs such as the "National Anthem" or "Auld Lang Syne" the total result is very far from being a true representation of the musical value of the song itself. Further, in listening to collective aboriginal songs, it is always easy to single out the song leader (precentor) who commences each strophe, and is immediately followed by the others. It is certain, therefore, that such a leader, performing alone, would give a truer rendering of the song to be recorded.

(2) Again, in massed singing without instrumental support, the pitch of the song is both fortuitous and arbitrary. It may chance to be too low at the outset, and then the lowest notes in the descending scale of sounds become an almost inaudible rumble. Or, on the other hand, commencing too high, the voices of

(1) Note.—More recent experience goes to show that a covering of soft felt on the recording horn is of much value in obviating the tendency to "blast."

the chorus are strained upwards, with ludicrous and unmusical effect. (Again one may observe that such accidents as these are not peculiar to aboriginal folk.) Frequently the songs heard showed a sudden change of pitch "in mediis rebus," due to the impulse of the singers to secure either greater effect, or a more comfortable range of tones. Thus great care was necessary in order to determine the true melodic outline of the song. For this reason also an individual performer offers the safer course. If his initial pitch be either too low or too high, it can be corrected by suggesting another note for the starting point; and this I frequently did.

On the whole, very little difficulty was experienced in securing the songs, and the only persuasion necessary was at the very outset. The plan was to begin with a chosen man, who, after a little preliminary discussion, would usually be willing to quietly hum through a song, beating the rhythm on two sticks. He was then gradually induced to repeat it more and more loudly until, by judicious encouragement (and the prospect of reward) he reached such a point of confidence as to sing right into the horn of the phonograph. Immediately the record had been made it was reproduced for his own hearing, and the effect was instant. Not only was he gratified and willing to make further records, but his pride was soon communicated to other natives, who came forward quite readily at later sittings. The lubras were more difficult, and in some cases (as at Alice Springs) a good deal of patience was required before they could be persuaded to sing. However, the course described above was ultimately effective, and one of the young lubras proved quite a valuable ally in obtaining other subjects. A portable gramaphone, with a varied selection of records, was also an excellent aid in developing both interest and confidence. It was further of some value in determining aboriginal reactions to European music.

III.—The Songs.

(a) Their general character. Of the thirty records taken at Macumba River and Alice Springs (certain of these being duplicates and variants) all were made by members of the Arunta tribe, the largest and most widely diffused tribe of Central Australia. The principal facts noted as to their general character were as follow:—

(1) No trace of a purely lyric impulse was observable, and apparently the emotions of love, of grief, or of joy, to whatever extent they exist among paleolithic men do not find instinctive expression through this medium. Further enquiries, however, may prove otherwise.[2]

The songs examined show a mildly epic (narrative) or descriptive tendency, suggestive of the child mind. They are not usually heroic, but rather sung to words which speak of obvious natural things (as might be expected from their association with the infinite variety of totems.) It is not safe to dogmatise on the strict meaning of these words; in fact, it would often seem that they are traditional and not always fully understood by the singers themselves. Careful questioning, however, elicited such slight explanations as the following:—

Goanna Song—Meaning "Him run away in the bush—catch 'um, make 'um fat and eat 'um."

Rat Song—Meaning "Rat come out of your hole."

---

(2) Note.—It is to be understood that the study of the words of the songs was not the immediate object of this investigation, and the opinions here expressed may therefore be considered as open to challenge. However, a very exhaustive review of their verbal text is available, published in the Proceedings of the Städtischen Völker-Museum, Frankfurt am Main, 1907, by Carl Strehlow, Missionar at Hermannsburg, and Von Leonhardi. A perusal of the many Arunta totem songs therein quoted only serves to support the impressions here set down.

Witchetty Grub Song—Meaning "Grub gone away into roots of the tree—can't find him."

Old Lubra's Song—Meaning "Tell 'um all come together in one camp" and then later "walk along the track."

Dead Man's Song—Meaning "Dead man all smashed up, lubras dance around"; or "Dead man buried, all finished."

Wild Dog Song—Meaning (addressing another pack of dogs) "This is my country—you go away."

The colloquial "pidgin" renderings are the actual words used by native interpreters, but whatever reliance may be placed on such translations, they certainly suggest a very elementary association of ideas; nor would they tend to such a level of emotional excitement as might naturally produce the "sing-song" (recitative) or "chant" style of declamation. It is more likely that the exalted feeling necessary to song belongs rather to the actual ceremonials with which the various chants are so closely linked, and that the several dances and ritual observances (calling, as they do, for concerted utterance and movement) are responsible for the tendency to sing words which intrinsically are not in the least emotional. This suggestion of a concerted utterance gains strength also from the rhythmic stick beating on the ground which is an invariable accompaniment.

(2) No rhapsodic songs were met with, but all of those recorded were of fairly definite form, and strophic in character, consisting apparently of brief verses sung to the same music over and over again. Except for slightly varying inflections the only difference noted in any given song was an occasional sudden change of pitch—generally to a higher key—incidental to an access of excitement; but the melodic outline remained virtually the same. Furthermore, in the great majority of cases—but with a few notable exceptions—the commencement of each song was a relatively high note followed by a gradual falling of pitch until the lower octave was reached, the final note being reiterated at some length with a diminishing intensity of tone which at last died away to nothing. In most instances a middle note (corresponding to the "dominant" of the Greek and European systems) was also strongly emphasised, and even returned to from below, before the final drop. Two outstanding observations are, first, the strong insistence on the relationship of the octave; and, second, the natural perception of the cadence as a falling progression.

(b) Rhythm.—Some kind of rhythmic reinforcement was an inevitable feature of all the songs that were heard. It is evidently an instinctive association, since, when deprived of it, the men singers who made the various records were obviously uneasy. Two small sticks always sufficed to supply the need, and in one case a native picked up an empty condensed milk tin lying on the camping ground, as the nearest thing to hand, and hummed through his song, at the same time drumming with two fingers on the bottom of the tin.

In the collective songs of the various ceremonials that were witnessed the stick-beating showed a constant synchronism with the pulse of the song. The strength of the beats was always proportioned to the fluctuating intensity of the feeling, but occasionally, as the excitement rose to a climax, or the speed of the song increased, the single pulse beat was exchanged for a two-pulse beat of tremendous emphasis, thus:—

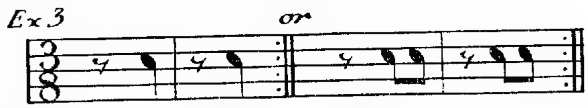
Ex 1

At the same time the accented note, with its associated syllable, was "pounded out" in a manner more suggestive of vociferous speech than song.

Most of the songs showed a simple duple rhythm, but in one or two cases a remarkable variant was heard consisting of a duple beat to a song in triple rhythm, thus:—

The relative complexity of such an association of sounds and beats is interesting; and since it happened both at Macumba and Stuart (350 miles apart) it could hardly be regarded as due to accident or lack of attention on the part of the performers:—

Apart from this unusual departure from the normal coincidence of song-pulse and stick-beat, the only other noteworthy peculiarities of rhythm occurred at Macumba, where one of the men sang a "Witchetty Grub" song in triple measure, accompanying it with a syncopated beat, thus:—



And again, a "Pelican" song in 6/8 time, beating thus:—

Both of these are unusual variations of the more normal and primitive rhythms, indicating a considerable advance in mentality. The first of them should, however, be viewed with some caution, since the native in question had possibly caught the more difficult rhythm from chance hearing of the ubiquitous gramaphone.

IV.—Aural Impressions.

Before making any phonograph records, I was present at certain ceremonials belonging to the initiation of a young man into tribal mysteries. Rough notes were made of a few of the songs associated with these rites, and although close attention was given to their main characteristics, only a limited value may attach to such casual observations, jotted down in the midst of an aboriginal drama of surpassing interest, viewed for the first time. The following are, therefore, set out for what they are worth, each of them embracing only one or two outstanding features of the song in question.

1. *Initiation Song.*—Main compass from middle C down to the octave (tenor C), with occasional but very definite use of the upper D as an ornamental note, thus:—

and also frequent corresponding emphasis on the middle notes A & G, thus:—

2. *Women's Corroboree.*—Six women danced, the men only singing a continuous series of short strophes (led by a precentor) each lasting about three-quarters of a minute, with a half-minute interval between the verses. The

initial pitch remained constant, commencing with a definite A and clearly embracing the following notes in various rhythmic permutations:—

Ex 7

but rising at times to a corresponding:—

Ex 8

The pitch of the note marked with an asterisk was indefinite, suggesting again an ornamental function. The striking feature is the decisive descending fourth interval and an incomplete tetrachord evolving out of it by the use of an additional decorative note. Furthermore, two such incomplete tetrachords linked together give rise to the pentatonic scale which is prominent in certain of the phonographic records made later.

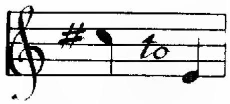
Ex 9

A persistent aural impression, increasing with the subsequent hearing of these records, would indicate that while each song presents certain notes of very definite pitch (and clearly related) the in-between notes, used ornamentally, are of more elastic pitch (enharmonics), and while one cannot speak with absolute conviction, the feeling seems to grow that in unaccompanied songs these enharmonic intervals present a richer and more varied effect than the mathematically ordered sequence of conjunctive tones and semi-tones belonging to the European system.

3. *Kurdaitcha (man-killing) Song* presents different features.

Main compass:—

Ex 10



A new rhythmic opening:—

Ex 11

Followed by the now familiar

Ex 12

suggesting A and E as the principal notes with B and F as ornamental.

Sudden bursts of high pitch thus:—

Ex 13

It was in these momentary frenzies that the normal crotchet or quaver stick-beating gave place to the furious emphasis of the single minim.

4. *Kangaroo Song,* pitched very high:—

or varied:—

dropping presently with more or less of a vocal slide to the lower octave. The whole song was rather rhythmic than melodic, but one significant feature appears in the following quite startling:—

indicating a very decisive sense of the major 3rd*.

It remains to cite one or two further notes taken of individual songs.

Emu Song.

In varying degrees and with a suggestion of patterning on its downward progress.

Possum Song, all the quaver beats being tapped.

Rain Song ("Old Cloud") shows an unusual rhythm:—

Again with a downward patterning.

Witchetty Song presents an opening phrase of quite remarkable melodic beauty:—

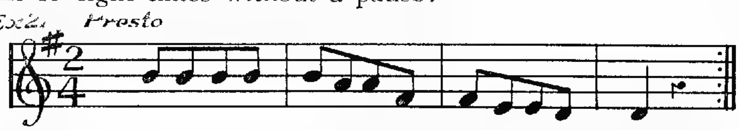
V.—The Records Secured.

Of the thirty or so of actual records, about a third are good reproductions, a similar number being less satisfactory, and the balance more or less defective and unreliable. A faithful transcription of those which are entirely good presents many difficulties:—(1) The speed is often from "Allegro" to "Presto," and the slight changes of inflection in the many ornamental notes are extremely elusive; (2) the constant use by the singer of a sliding progression between two firmly intoned sounds—it may be a 3rd or 4th apart—is almost beyond reproduction in printed terms, especially at the rapid tempo; (3) additional to these are subtle rhythmic deviations, of comparatively frequent occurrence.

To the musical hearing, however, a purely melodic art seems rather to gain by the greater elasticity of such devices, and while the effect of a certain indefiniteness is always perceived, it is only just enough to veil the clear rhythmic and tonal outlines underlying. The following songs are submitted in their entirety:—

1. "*Rat*" *Song*, sung by an aboriginal at Stuart, consists of a single phrase repeated six or eight times without a pause:—

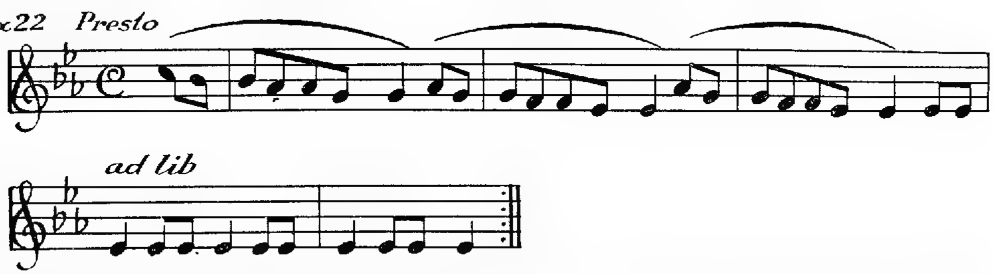
Ex21



The interest of this is wholly tonal, since it presents the widely used pentatonic scale characteristic of Gaelic and Chinese music equally. Rhythmically and structurally it is quite elemental. The pitch relations were faultlessly intoned.

2. "*Possum*" *Song*, by the same singer, has a slightly more organic character, showing a sense of phrase balance, as well as the "pattern" instinct:—

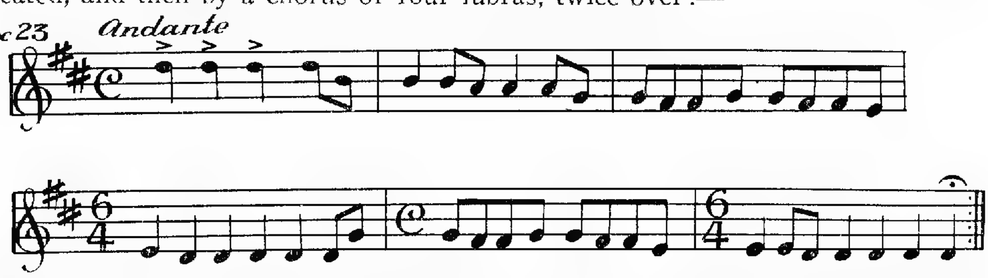
Ex22



In this there is also the clearest possible indication of the hexatonic scale, which occurs again in the "Ring Neck" Song.

3. "*Ring Neck Parrot*" *Song*, by a lubra at Stuart, first as a solo, three times repeated, and then by a chorus of four lubras, twice over:—

Ex23



In this example, besides its definite tonal formation, is seen a more highly organised structure, and the rhythmic diversity of the interpolated 6/4 bars, as well as the figure of bar 3 repeated in bar 5, seem to indicate an instinctive sense of the universal art principle of "variety in unity."

4. *"Witchetty Grub" Song,* by a native at Macumba, in its several repeats presents many slight variations of detail, but in substance is as follows:—

Ex 24


The whole song suggests a novel pentatonic formation:—

Ex 25


5. *"Pelican" Song,* a rollicking and vigorous tune, sung first as a solo, and then repeated as a chorus with great gusto:—

Ex 26


The stick beat accompanying this song was uniformly maintained, thus:—

Ex 27


Its tonal interest specially lies in the use of the melodic minor scale, the sense of which is so strongly enforced by the sound of the initial note. As usual, slight variations of both time values and inflections are frequent, but the above notation is substantially accurate.

Since making the records above, I have had an opportunity of visiting Swan Reach, on the River Murray, and of obtaining there what is probably the only remaining song of the River Murray tribes. This is now submitted as follows:—

It may be noticed that the general structure of this song, sung by an old blackfellow named Fletcher, nearly 70 years of age, is practically identical with many of the songs obtained in Central Australia, although a thousand geographical miles lie between them. The range of the song covers the compass of an octave, with stress on an ornamental note above the upper keynote, and emphasis also upon the middle note G. The resemblance is very remarkable, and points to a prevailing idiom which has evolved out of common experience.

VI.—General Musical Susceptibility of Natives.

On this point a few observations may be offered. Many tests were made such as those mentioned by Howitt, and it was found that the aboriginal readily responded to the pitch of any given note. In order to ascertain this, a single sound was either sung, or a tuning fork struck, and in most instances the native immediately imitated the sound at an absolutely true pitch. In certain cases two or three attempts were necessary before succeeding, and it was curious to watch the gradual process of co-ordination between the auditory and vocal nerve centres, the difficulty being obviously not in a true hearing but rather in conscious voice-control. Further tests showed an equal ability to imitate two, three, or more, successive sounds of different pitch, proving the existence of a ready susceptibility to the various degrees of our own scale systems.

As bearing upon and confirming this natural sensibility, it was also noticed that the aboriginal has a highly developed ear in the matter of vowel distinctions. While endeavouring to pronounce words in the Arunta language, I was corrected time after time, with the utmost patience and insistence (always good-humored) on the part of the blackfellow, until he had secured the exact inflection desired. These distinctions resembled the delicate differences between the French nasals *an*, *en*, and *in*, which are often almost insuperable to an Englishman.

In the matter of reactions to various types of European music, no extensive trials were made, but it was noticed that a general preference was shown for the more serious gramaphone records, especially of good songs, to which the aboriginals listened with avid interest, frequently asking for their repetition. Beyond this, no serious attempt was made to gauge their sense of musical appreciation.

VII.—The Voices of the Natives.

Usually a remarkable difference exists between the voices of Australian natives in speech and in song. In speech there is not the slightest trace of harshness, but rather a uniformly beautiful and musical quality, suffused with a slight breathiness, or huskiness, which rather adds to its charm. The voices are never raised (except in calling at a distance, or possibly in recrimination), but more often sink to a whisper. In actual song, however, the voice often suffers an unpleasant transformation, due entirely to an ignorance of methods of *voice production.* From the beautiful natural speech quality it is often raised to a high nasal whine, in which a forced use of the *chest* register is the prominent fault. The higher the pitch of the song the more unpleasant the sounds become. That this is abnormal was proved in several instances. One of the singers at Macumba, who was responsible for several phonographic records, in preliminary attempts sang in a natural way, with a tone that was definitely musical and agreeable to hear. Similarly, at Stuart a young lubra instinctively used her *medium* register to hum through a little song called the "Ring-necked Parrot," and then, when placed in front of the recording horn, instantly started off in high, forced, chest notes which completely destroyed the purely musical effect of her performance. That a very little teaching will correct this habit is proved by my own previous experience of two aboriginal children who, under civilized influences, have developed singing voices of real beauty, as well as showing a quick aptitude for our own musical idioms.

In point of range the men's voices showed a baritone or tenor quality, no deep bass voices being heard.

VIII.—Brief Notes on Phonetics.

In passing it may be noted how rich the Arunta language is in vocal (vowel) content. The following translation of the first two verses of the Song of Mary, Luke i. 46, 47,[3] will make this clear:—

46. Mariala ilaka tuta: Guruña nukanala Inkatana tnantjama.

47. Ltana nuka arganerama Altjira, lunaluna nukibera tuta.

(And Mary said: "My soul doth magnify the Lord
And my spirit hath rejoiced in God my Saviour.")

The overwhelming prevalence of the full-throated "ah" (an invariable terminal), as well as the total absence of sibilants (S and Z) and the consonants F and V combine to intensify the musical effect. The free use of double initial consonants such as tm, tn, nt, nk, nd, ng, mb, etc., also suggest a likeness to certain African languages.

Incidentally it is a matter of much speculative interest as to how far natural musical tendencies in a race may be reflected in the character of its language. That languages differ very markedly in vocal content is clear; a comparison between English and Italian affords convincing evidence of this fact. And since the only essential difference between speech and song lies in the lengthening, or sustaining, of the vocals at definite musical levels, it follows that that language which is richest in vowels (vocals) may be so simply by virtue of a primeval song instinct, developing co-incidentally with speech. On the other hand, it may appear that such languages will subsequently favour an earlier development of the art of music in those who speak them.

---

(3) Note.—The Gospel according to St. Luke has been rendered into Arunta by Carl Strehlow, of the Hermannsburg Mission, and is published by the British and Foreign Bible Society.

IX.—Native Musical Instruments.

No musical instrument was used in any of the songs that were heard, nor was any trace of one seen on the present Expedition. Enquiries among available sources of information disclose the fact that a hollow tree branch or bamboo (producing a single note, like a horn blast) is sometimes used, and this I have heard in certain of Sir Baldwin Spencer's records. Mr. Johannsen, an old resident of Central Australia, also states that a rude pan-pipes made of hollow bones was occasionally to be met with, never, however, played alone as a musical instrument, but rather (as in the case of the horn) to add to the general noise, and particularly to enforce the rhythmic pulsation of the songs.

It would, therefore, seem to be certain that the various pitch relationships, corresponding to those in use in the European musical system, have been arrived at by the Australian aboriginal from an instinctive sense of effective tone contrast, and as a result of purely vocal experience. This fact is of considerable importance, since the general view of musical evolutionists has hitherto been that the existence of rude instruments (either strings or pipes) would probably *precede,* and lead to, definite pitch associations in the form of organised melody.

X.—Summary.

In brief, the following conclusions may be advanced from the materials now presented:—

1. A considerable variety exists in the general character of the songs, tonally and rhythmically, as well as in their emotional content; and these marked differences are apparent in spite of a certain *sameness of idiom* due (a) to the prevalent falling progression from an upper keynote to the octave below, and (b) to the prominence of the downward fourth interval, coupled with the ornamental notes immediately above both key note and fourth below.

That the aboriginal himself is conscious of wide differences in the character and identity of his songs is proved by his ability to make two strongly contrastive records on the same cylinder, with only a moment's pause between. This happened in three or four instances, and notably at Stuart, where both rhythm and tonality were changed in quick succession by the same singer.

2. In point of form (structure) the songs are quite definite, and for the most part strongly coherent and logical. With the exception of No. 1 cited above, which is limited to a single phrase, they are well organised and surprisingly effective.

3. Such a development of the expressive sense in so primitive a race is worthy of further enquiry and close study. Vocal utterance of the purely instinctive order is apparently not confined to language only.

It is hoped at a later time to add to the examples here given which, though few in number, are of great evidential value.

The material of the records already made is by no means exhausted as yet, and doubtless there will be future opportunities of securing many further records from other localities.

It will also be necessary to convert the highly perishable wax cylinders into some more permanent substance, perhaps re-recording them in disc form, with such amplification of tone as will secure their effectiveness for public hearing.

ON NEW SPECIES OF EMPLESIS (CURCULIONIDAE).

By ARTHUR M. LEA, F.E.S.

(Contribution from the South Australian Museum.)

[Read June 9, 1927.]

The genus *Emplesis* consists of a large number of small weevils, many of which live beneath the bark of eucalypti, and may be obtained in very large numbers. In general it appears to be close to *Storeus*, and at one time I proposed amalgamating the two genera. As the claws, however, are simple, except for a slight basal swelling, in *Emplesis*, and truly appendiculate, in *Storeus* (although it is often necessary to use a compound power to examine them), I recently again separated them, and dealt with the species of the latter genus in the Records of the Queensland Museum.

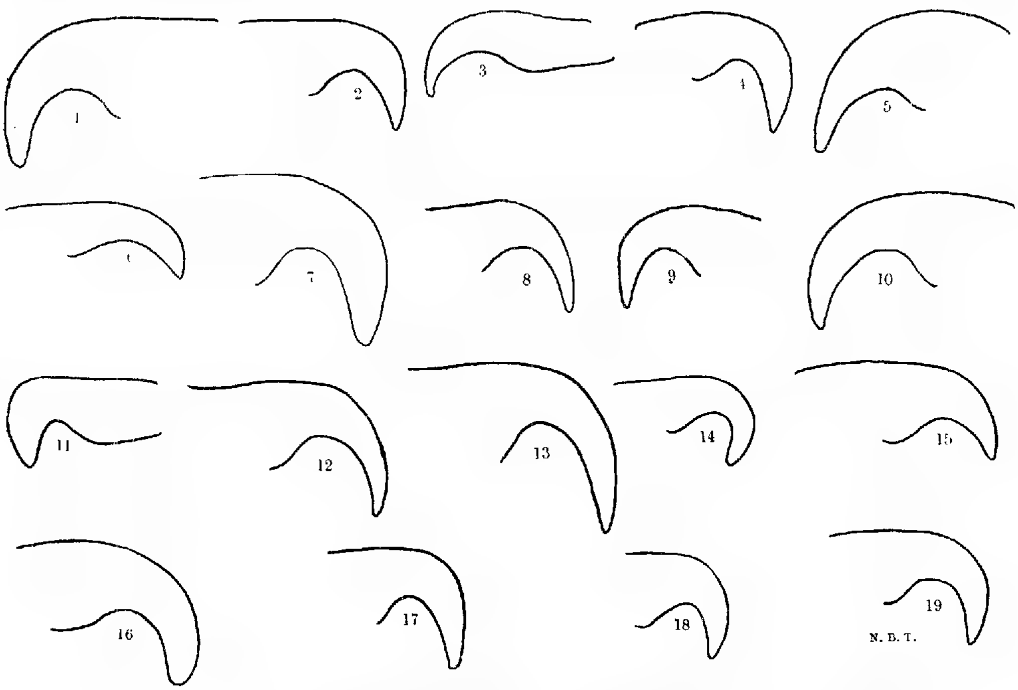


Fig. A. Claws of species of *Emplesis*. 1, *filirostris*, Pasc.; 2, *scolopax*, Pasc.; 3, *assimilis*, Blackb.; 4, *mundas*, Blackb.; 5, 6, *amoena*, Lea; 7, *bifoveata*, Lea; 8, *composita*, Lea; 9, *grata*, Lea; 10, *lata*, Lea; 11, *lithostrota*, Lea; 12, *longicollis*, Lea; 13, *microsticta*, Lea; 14, *multiarticulata*, Lea; 15, *nigrofasciata*, Lea; 16, *parilis*, Lea; 17, *parvidens*, Lea; 18, *picta*, Lea; 19, *tibialis*, Lea.

EMPLESIS ASSIMILIS, Blackb.

Numerous specimens from the Fortescue River (North-Western Australia) appear to represent a variety of this species; they differ from typical specimens in being somewhat more brightly coloured, and with the rostrum of the female a little longer. They are also extremely close to *E. aenigmatica*. On the apical segment of the abdomen the clothing in some lights appears golden.

Emplesis ignobilis, Lea.

The type of this species was in rather poor condition. Numerous specimens now under examination (from New South Wales, Tasmania, and South Australia) have the scales mostly of a rusty-red colour, with numerous ochreous and black spots alternately arranged, especially on the odd interstices, on the third there are usually four black and five ochreous ones (but on several specimens the contrasts are not very obvious); on the pronotum there are two dark triangles at the base, and a conspicuous median line. On the head there is a remnant of a crest, fairly distinct but much less elevated than on *E. scolopax*. The female differs from the male in having the rostrum much longer, strongly curved, polished and almost impunctate, abdomen gently convex and the fifth segment shorter. The species is slightly larger than *E. suturalis*, the rostrum of both sexes is longer, and the blackish spots on the elytra are more numerous and isolated. The rostrum of the female is somewhat shorter than on *E. dispar* and more curved. The type was stated to have the "elytra without lines of setae." They are, however, present, although depressed on it, but on many of the fresh specimens they are conspicuous.

Emplesis nigrofasciata, Lea.

Some specimens from Lucindale (South Australia) are larger, up to 3·5 mm., than usual.

Emplesis biachyderes, Lea.

A male from Mount Lofty (South Australia) has the three vittae of the pronotum darker and more conspicuous than usual, and the dark scales of the elytra more numerous. One from Gosford (New South Wales) is unusually small, 2·75 mm.

Emplesis ovalisticta, n. sp.

♂. Dark reddish-brown, metasternum more or less blackish. Densely clothed with ochreous-brown scales variegated with paler and darker spots, and with a conspicuous sub-oval blackish patch beginning at the suture on the basal half of the elytra; scales on under surface and legs stramineous or whitish.

Rostrum slightly longer than prothorax, moderately curved, slightly dilated between antennae and base; with fine costae, alternated with rows of squamiferous punctures to insertion of antennae, at apical third, beyond which there are only punctures. Prothorax widely transverse, apex suddenly narrowed and sub-tubular; with crowded, concealed punctures. Elytra elongate, base trisinuate and not much wider than widest part of prothorax; with regular rows of large, partially concealed punctures. Two basal segments of abdomen with a wide shallow depression, continued on to metasternum. Femora stout, grooved and edentate. Length, 4-4·5 mm.

♀. Differs in having rostrum longer, much thinner, more strongly curved, without ridges, with minute punctures, and clothed only at extreme base; antennae inserted just perceptibly nearer base than apex of rostrum; abdomen evenly convex, and fifth segment slightly smaller.

Australia (J. Faust from C. A. Dohrn). Queensland: Atherton (Dr. E. Mjöberg), Stradbroke Island (J. H. Boreham), Brisbane (T. G. Sloane). Type, I. 16237, in South Australian Museum, cotypes in Queensland and Stockholm Museums.

A tessellated species, but distinct by the dark and more or less oval patch on the elytra, slightly variable in extent, but constant on the 48 specimens under examination. On the elytra of specimens in good condition there are numerous pale and dark spots, and the former form one or more feeble wide V's on the apical half; on the pronotum the clothing is slightly variegated, but there is a narrow blackish triangle on each side of the base.

On this and all the other new species, unless otherwise noted, the prothorax has dense punctures more or less concealed by the scales; the elytra have regular rows of punctures of moderate or large size, but always appearing much smaller through the clothing and often simulating striae on the sides; the punctures on the interstices are small and always concealed except where scales have been removed. The antennae are uniformly coloured, or at least the club is not black. The femora are edentate, and grooved, the grooves distinct on the hind ones, less distinct on the middle ones, and feeble or absent from the others.

Emplesis suturalis, n. sp.

♂. Dark reddish-brown. Densely clothed with rust-brown scales, conspicuously variegated with paler and darker spots; under surface and legs with whitish scales.

Rostrum feebly curved, parallel-sided, slightly longer than prothorax; with fine ridges, alternated with rows of squamiferous punctures from base to apical third (where the antennae are inserted), thence with dense, sharply defined, naked punctures. Prothorax strongly transverse, sides parallel to near apex, which is suddenly sub-tubular. Elytra elongate, base feebly trisinuate. Abdomen with a shallow depression common to two basal segments, fifth slightly longer than second and third combined. Femora stout, the hind ones strongly grooved. Length, 3·5-4 mm.

♀. Differs in having the rostrum longer, thinner, more curved, clothed only at extreme base, without ridges and almost impunctate; antennae inserted almost in exact middle of sides of rostrum; abdomen evenly convex and fifth segment shorter than second and third combined.

Western Queensland (Blackburn's Collection). Type, I. 16238, in South Australian Museum, cotype in Queensland Museum.

A tessellated species, with the sutural clothing dark throughout; two or three wide V's formed by pale spots may be traced on the elytra, there are four distinct dark spots on the third interstice, and they are fairly numerous on the sides and apical slope; on the pronotum two narrow dark triangles are conspicuous, and there is usually a narrow and moderately dark median line. The clothing of the scutellum, as on most of the tessellated species, is conspicuously whitish. The rostrum of both sexes is shorter than on *E. aenigmatica*, and the clothing is brighter; on that species the dark spots on the elytra are isolated, on this species many of them are obliquely connected with the suture.

var. meridionalis, n. var.

Some specimens from South Australia appear to represent a variety of this species, the general clothing is slightly paler and the rostrum of the male is very slightly shorter; on several of them the pale V's extend quite to the suture.

South Australia: Lucindale (B. A. Feuerheerdt), Mount Lofty Ranges (N. B. Tindale), Gawler (A. M. Lea).

Emplesis cylindrirostris, n. sp.

♂. Dark reddish-brown, suture infuscated. Densely clothed with muddy-grey scales, variegated with paler and darker spots, and with a fairly large dark fascia crowning the apical slope of elytra; under surface and legs with whitish scales.

Rostrum almost straight, the length of prothorax, parallel-sided, apical third with naked punctures, elsewhere with dense scales, partly concealing punctures and ridges. Prothorax strongly transverse, almost parallel-sided to near apex, which is suddenly narrowed. Elytra narrow, base feebly trisinuate. Abdomen

with a shallow depression common to the two basal segments, fifth slightly longer than second. Femora stout, feebly grooved. Length, 3-3·25 mm.

♀. Differs in having the rostrum considerably longer and thinner, almost impunctate, antennae inserted slightly nearer base than apex (instead of at apical third), basal segments of abdomen flat in middle and fifth no longer than second.

Queensland: Townsville (F. P. Dodd), Magnetic Island (A. M. Lea). Type, I. 16239.

A narrow, faintly tessellated species, with the rostrum almost straight in both sexes. The dark fascia extends across about four interstices on each elytron, but on two (of the five) specimens before me is rather feeble; it is followed by a narrower fascia of pale spots, between it and the base the pale spots are fairly numerous but feebly defined; on the pronotum the median line and the two dark basal triangles are inconspicuous.

Emplesis submunda, n. sp.

♂. Reddish-brown, metasternum slightly darker than abdomen. Densely clothed with brownish scales, variegated with paler and darker spots, under surface and legs with whitish scales.

Rostrum about the length of prothorax, feebly curved, parallel-sided; with narrow ridges, alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with naked, sharply defined punctures. Prothorax moderately transverse. Elytra rather narrow, parallel-sided to beyond the middle, base feebly trisinuate. Abdomen with a feeble depression common to first and second segments, fifth distinctly longer than second and third combined. Legs short and stout. Length, 3 mm.

Queensland: Mount Tambourine. Type (unique), I. 16240.

A narrow, tessellated species, in general appearance like small narrow *E. munda*, but rostrum distinctly shorter and thicker. The elytra have pale spots in three oblique series on each, or four if a less distinct sub-apical series is included, the darker spots are very feeble; on the pronotum the variegation is feeble, and the two basal triangles are ill-defined.

Emplesis intermixta, n. sp.

♂. Reddish-brown, metasternum somewhat darker. Densely clothed with variegated scales, becoming almost white on under surface and legs.

Rostrum the length of prothorax, slightly curved, parallel-sided, with narrow ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), apex with small, sharply defined, naked punctures. Prothorax moderately transverse, sides gently rounded to near apex, which is subtubular. Elytra somewhat wider than prothorax than is usual, base feebly trisinuate. Abdomen with a shallow depression common to two basal segments, fifth very little longer than second. Length, 3·5 mm.

Queensland: Cairns. Type, I. 16241.

A tessellated species, with the dark scales, except for a few small spots, covering the median half of the pronotum; on most of the elytral interstices there are small dark-brown spots, alternated with longer and paler ones, and there is a fairly large dark spot crowning the apical slope, followed by a fascia of pale spots. At first glance it seems fairly close to some of the darker forms of *E. aenigmatica*, but, in addition to the different tessellation, the claw joint of the front tarsi scarcely projects beyond the lobes of the third, the claws themselves appearing to rest on its fringe. The eyes are separated less than the width of the base of rostrum.

Emplesis subuniformis, n. sp.

♂. Dull reddish-brown, suture narrowly infuscated. Moderately clothed with pale brownish-stramineous scales, feebly variegated on upper surface, and slightly paler on under surface and legs.

Rostrum slightly longer than prothorax, moderately curved, parallel-sided; with fine ridges alternated with rows of squamiferous punctures between base and apical third (where the antennae are inserted), in front with dense, naked punctures. Prothorax strongly transverse, sides gently rounded, apex subtubular. Elytra elongate, base feebly trisinuate. Abdomen with a shallow depression, common to the two basal segments, the fifth slightly longer than second and third combined. Length, 3·25-5 mm.

♀. Differs in having the rostrum thinner, longer and strongly curved, antennae inserted just perceptibly nearer apex than base, rows of punctures and ridges feeble behind them, almost impunctate in front, abdomen evenly convex and apical segment shorter than second and third combined.

Queensland: Blackburn's Collection. Type, I. 16242.

The tessellation is so faint that the clothing might almost be regarded as uniform, nevertheless on some of the lateral interstices the alternation of pale and dark spots is fairly distinct; the two dark spots at the base of the pronotum are scarcely evident. In some lights some of the scales on the head and front of pronotum have a faint golden lustre. The rostrum of the female is strongly curved, almost as on *E. femoralis,* to which in other respects it is fairly close, except for the weaker tessellation; it is larger than *E. mediocris*, and the female rostrum is more strongly curved.

Emplesis bituberculata, n. sp.

♂. Dull reddish-brown, antennae and tarsi paler. Densely clothed with stramineous, brown and blackish scales, becoming whitish on under surface of body and of legs.

Rostrum the length of prothorax, almost straight, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical fourth (where the antennae are inserted), in front with crowded, naked punctures. Prothorax moderately transverse, sides gently rounded but apex sub-tubular. Elytra nowhere quite parallel-sided, base feebly trisinuate. Under surface with a depression continuous from near base of metasternum to apex of abdomen, and deeper on basal than on apical half, on each side of it on basal segment of abdomen a conspicuous rounded tubercle. Length, 3·25-3·5 mm.

Queensland: Mount Tambourine (H. Hacker in November, A. M. Lea in January). Type, I. 16243, in South Australian Museum, cotype in Queensland Museum.

A tessellated species, but readily distinguished from all previously described ones by the bituberculate abdomen. There is a large elongate patch of black scales on the side of each elytron, elsewhere brown and stramineous scales are irregularly mingled; on the pronotum the usual two basal dark triangles are scarcely defined.

var. tasmaniensis, n. var.

Four specimens from Tasmania evidently represent a variety; they differ in being considerably darker, blackish, except for the antennae and tarsi, but the elytra are without black patches of scales, stramineous and dark-brown ones being irregularly intermingled on the upper surface, the rostrum is slightly longer and the depression on the under surface is not continued beyond the second segment of abdomen, the apical segment is longer, and the two basal tubercles are slightly larger.

♀. Differs from the male in having the rostrum longer, thinner, cylindrical, polished black, and without punctures or ridges, antennae inserted nearer base than apex of rostrum, abdomen gently convex, non-tuberculate, and apical segment not as long as second and third combined, instead of slightly longer.

Tasmania: Hobart and Burnie (A. M. Lea).

Emplesis alphabetica, n. sp.

♂. Reddish-brown, rostrum, antennae and tarsi somewhat paler. Moderately clothed with stramineous-brown scales, variegated with paler and darker spots; on under parts uniformly whitish.

Rostrum slightly curved, about the length of prothorax; with narrow ridges alternated with squamiferous rows of punctures to apical third (where the antennae are inserted); in front with dense, naked punctures. Prothorax moderately transverse, sides comparatively strongly rounded and apex not suddenly sub-tubular. Elytra narrow, basal third parallel-sided, base very feebly trisinuate. Abdomen more convex, and with a smaller depression than is usual on two basal segments. Legs comparatively short and stout. Length, 2·5 mm.

Queensland: Dalby (Mrs. F. H. Hobler), unique.

A small, tessellated species, narrowly elliptic in appearance, although the outlines of the prothorax and elytra are not continuous. On the middle of the fifth interstice, on each elytron, there is a narrow whitish spot, and one on each interstice to the suture half-way down the apical slope, the whole forming a rather conspicuous V; there are also a few other pale spots on the elytra, the dark spots are more numerous but less conspicuous; on the pronotum there are two dark basal spots and a less distinct median line, with a few feeble scattered spots.

Emplesis pulicosa, n. sp.

♂. Of a dull, pale reddish-brown. Densely clothed with stramineous-grey scales, the elytra conspicuously tessellated, and with a deep black patch crowning the apical slope, scales on under surface and legs almost white.

Rostrum rather thin, parallel-sided, slightly curved, almost the length of prothorax; ridged and punctate to insertion of antennae (at apical third), thence with rather dense punctures. Prothorax slightly transverse, sides almost parallel to near apex. Elytra thin, base very feebly trisinuate, basal third parallel-sided. Two basal segments of abdomen feebly depressed in middle, the fifth not quite as long as second and third combined, legs short. Length, 2·5 mm.

Queensland: Longreach (A. M. Lea). Type (unique), I. 16244.

A narrow, tessellated species. The pale scales on the elytra form numerous narrow spots, alternated with smaller dark ones, similar in colour to the derm; the patch of black scales extends across about six interstices on each elytron, and the pale spots preceding and following it are more conspicuous than the others; on the pronotum the two dark sub-triangular basal marks are distinct, and there is a fairly distinct median line, narrowing in front, the setae are numerous and give the surface a speckled appearance, although of much the same colour as the scales amongst which they are set. The clothing of the rostrum completely conceals the sculpture of the basal fourth, and from there to the apical third the ridges are distinct, but the scales thin out. The tessellation is more conspicuous than on *E. cylindrirostris,* there is more black on the elytra, the rostrum is more curved and the size is less.

A female from New South Wales (H. J. Carter) probably belongs to the species. Its rostrum is slightly longer, thinner, and more curved on the male, and its abdomen is evenly convex; its elytra have the suture blackish, and the irregular black patch at the summit of the apical slope appears as a black spot on each elytron, separated from the suture by the second and third interstices. It

is considerably narrower than *E. sublecta,* but the markings approach those of some specimens of that species.

Emplesis curvirostris, n. sp.

♀. Reddish-brown, metasternum and club blackish. Clothed with stramineous and brownish scales, becoming white on under surface and legs.

Rostrum long, thin, strongly curved, glabrous and minutely punctate. Antennae inserted just perceptibly nearer apex than base of rostrum. Prothorax moderately transverse, sides rounded, apex about half the width of base. Elytra elongate-subcordate. Fifth segment of abdomen scarcely longer than second. Length, 2 mm.

Queensland: Bribie Island (H. Hacker and A. M. Lea). Type, I. 16245, in South Australian Museum, cotype in Queensland Museum.

A small species, apparently intermediate between the *tessellata* and *niveiceps* groups. The pale spots on the elytra are narrow, and each is confined to a single interstice, as on other tessellated species, but they are not sharply defined; several of them may be regarded as forming a feeble fascia just before summit of apical slope, and another half-way down it; on the pronotum two dark basal marks are fairly large, and there is a median line, but they are not sharply defined, the rest of its surface has a speckled appearance.

Five specimens, all females, were obtained, but the species is distinct by the small size, long curved rostrum and black club; it is about as long as *E. impotens,* but is wider.

Emplesis macrosticta, n. sp.

♀. Dull reddish-brown, metasternum darker. Densely clothed with whitish scales, a large black spot on elytra, and some feeble brownish ones.

Rostrum long, thin, moderately curved; with rows of fine punctures to insertion of antennae (slightly nearer apex than base), and glabrous, except at extreme base. Prothorax moderately transverse, sides rather strongly rounded. Elytra, for the genus, comparatively wide, base very feebly trisinuate. Fifth segment of abdomen the length of second. Length, 2·75 mm.

Northern Queensland (Blackburn's Collection). Type (unique), I. 16246.

This should probably be regarded as a tessellated species, but the tessellation is feeble and confined to the apical half of elytra. The large spot commences near the base, terminates before the middle, and is sharply terminated by the third stria on each elytron, the clothing margining it is whiter than elsewhere; on the pronotum there is a median line, and two sub-triangular basal spots of brownish scales.

Emplesis squamivaria, n. sp.

♂. Blackish-brown, legs, rostrum and antennae obscurely paler. Densely clothed with variegated scales, becoming sparser and almost white on under surface and legs.

Rostrum slightly longer than prothorax, slightly curved, parallel-sided, with fine ridges alternated with squamiferous rows of punctures from base to apical third, where the antennae are inserted, in front with small naked punctures. Prothorax strongly transverse. Elytra elongate-subcordate, base moderately trisinuate. First and second segments of abdomen with a wide depression continued on to metasternum, and feebly on to third and fourth, fifth slightly longer than second and third combined and with a large round depression. Femora stout, the middle and hind ones distinctly grooved. Length, 3·5 mm.

Northern Territory: Darwin (G. F. Hill and W. K. Hunt).

A fairly stout somewhat tessellated species. The clothing of the upper surface is white, ochreous and brown irregularly mingled, and on the elytra there is a large black spot on each side, although not quite as on *E. bituberculata.* The

derm of the type is almost entirely blackish; the second specimen is much paler, being pale reddish-castaneous (probably from immaturity); its clothing is less variegated, the dark elytral spots being scarcely black, and the scales of the pronotum being silvery-white and brown, in irregular alternate vittae.

Emplesis vitticollis, n. sp.

♂. Dark reddish-brown, antennae and tarsi somewhat paler. Densely clothed with slaty-white, stramineous and brown scales, becoming white on under parts.

Rostrum rather stout, slightly shorter than prothorax, almost straight, parallel-sided; ridges and punctures completely concealed by scales to apical fourth, where the antennae are inserted, tip with dense and small but sharply defined punctures. Prothorax almost as long as the basal width, sides gently rounded but strongly narrowed at apex. Elytra thin, almost parallel-sided to beyond the middle. Abdomen with a shallow depression continuous from near base to base of fifth segment, fifth slightly longer than second and third combined. Length, 2·25-2·75 mm.

Northern Territory (Capt. S. A. White). Type, I. 16249.

A narrow somewhat obscurely tessellated species. The clothing on the inner half of the elytra is irregularly intermingled, on the sides the tessellation being more pronounced; on the pronotum there are three fairly well-defined dark vittae and two pale ones, the sides being irregularly spotted. The prothorax is longer than is usual and the claws are more strongly exserted. In appearance it is fairly close to *E. submunda*, but the tessellation of both prothorax and elytra is on a somewhat different plan, and the rostrum is stouter.

Emplesis microsticta, n. sp.

Blackish, antennae (club blackish) and tarsi obscurely reddish. Densely clothed with ochreous scales intermingled with small black and white spots, under parts with stramineous clothing.

Rostrum the length of prothorax, moderately curved, parallel-sided, with seven distinct ridges alternated with rows of punctures between base and antennae (at apical fourth), in front with numerous sharply defined punctures. Prothorax about as long as the basal width, sides rather strongly rounded. Elytra elongate-subcordate, sides nowhere parallel. Abdomen somewhat flattened but not depressed along middle, third and fourth segments combined slightly longer than fifth and decidedly longer than second. Legs somewhat longer than usual; front femora moderately, the others deeply grooved. Length, 4·5 mm.

New South Wales: Blue Mountains (Dr. E. W. Ferguson), unique.

A speckled species somewhat resembling *Storeus albosignatus* on an enlarged scale, but with claws swollen at the base instead of appendiculate. The seriate punctures on the elytra are narrower than usual and each contains a thin seta. On the elytra the black and white spots are about equally numerous, but the white ones are usually smaller and more conspicuous, occasionally a single white seta is isolated; on the pronotum there are no white scales, and the black ones are irregularly distributed; on the head the clothing is entirely ochreous. The abdomen is without a longitudinal depression and its fifth segment is comparatively short, these being feminine characters, but the structure of the rostrum (although the seriate punctures are not squamiferous), and the insertion of antennae appear to render it certain that the type is a male.

Emplesis brevimana, n. sp.

♂. Pale reddish-castaneous. Densely clothed with pale buff scales tessellated with pale-brown ones, on under parts becoming white.

Rostrum long, rather thin, moderately curved, with fine ridges alternated with rows of squamiferous punctures on basal half, slightly beyond which the antennae are inserted, apical half with small naked punctures. Prothorax moderately transverse, apical third rather strongly narrowed. Elytra rather narrow, base feebly trisinuate. Abdomen shallowly depressed along middle of first and second segments, fifth slightly longer than second and third combined. Legs short, femora feebly grooved, claw joint of front tarsi just passing lobes of the third, of the others not at all. Length, 2-2·5 mm.

♀. Differs in having the rostrum longer, thinner, more strongly curved, glabrous and almost impunctate, without ridges, antennae inserted slightly nearer its base than apex, and fifth segment of abdomen shorter than first and second combined.

New South Wales: Barellan (A. M. Lea), Bogan River (J. Armstrong). South Australia: Quorn (A. H. Elston). Type, I. 16250.

A small species, with soft tessellated scales, and without seriate rows of elytral setae; about the size of *E. juvenca*, but very distinct by the unusually short claw joint. The tessellation of the scales is fairly sharply defined, although the two colours are not strongly contrasted; but the pattern is not alike on any two specimens before me. The type male, from Barellan, has the metasternum no darker than the adjacent parts; of two females from the Bogan River one has the metasternum slightly darker than the adjacent parts, but on the other it is black. A male, from Quorn, has the metasternum and part of the abdomen black; the tessellation of its upper surface is so faint that the clothing might fairly be regarded as uniform.

Two males and a female have just been received from the Bogan River; of these the males have the metasternum and abdomen (except the apical segment) black, densely covered with white scales; the female has the metasternum only black, and the tessellation of its upper surface fairly pronounced.

Emplesis nigrirostris, n. sp.

♀. Black, apex of prothorax, claw joints, scape and basal joint of funicle reddish. Densely clothed with sooty and whitish scales, irregularly intermingled on upper surface; on scutellum and under parts white.

Rostrum distinctly longer than prothorax, thin, strongly curved, shining and impunctate; antennae inserted scarcely perceptibly nearer base than apex. Prothorax strongly transverse, sides strongly rounded. Elytra feebly trisinuate at base, basal third almost parallel-sided. Abdomen gently convex, fifth segment almost as long as second and third combined. Middle and hind femora very feebly grooved, the others not at all. Length, 4 mm.

Victoria: Mount Buffalo (Rev. T. Blackburn). Type (unique), I. 16253.

The type was named, although a female, as it is very distinct by the black colour of its body and most of its antennae. It has the strongly curved and polished black rostrum and partly black antennae of *E. monticola*, but is larger, elytra black and clothing different. Parts of the elytra might be regarded as obscurely tessellated.

Emplesis squamirostris, n. sp.

♂. Black, antennae and claw joints reddish. Densely clothed with muddy-grey scales, feebly tessellated with sooty-brown spots, becoming almost white on under parts.

Rostrum distinctly longer than prothorax, almost straight, parallel-sided, with a conspicuous swelling at base, clothed almost to tip with the ridges and seriate punctures concealed, tip with small crowded punctures. Prothorax moderately transverse, sides gently rounded, but apex suddenly narrowed. Elytra rather narrow, basal half parallel-sided, base very feebly trisinuate. Abdomen

flattened but not depressed along middle, fifth segment slightly shorter than second and third combined. Length, 3-3·5 mm.

Victoria: Birchip in July (J. C. Goudie).

A dingy species like *E. gravis,* but the rostrum much as on *E. tuberculifrons;* the elytra, however, have but two obscurely contrasted shades of colour, not three distinct ones, as on that species. On *E. scolopax* the interocular clothing is in the form of fascicles and the general clothing is paler. *E. lineigera* is evidently allied, but appears to be a paler and more conspicuously tessellated species. The clothing of the rostrum is continued well beyond the insertion of antennae (at apical two-fifths), a rather unusual character. There are lines of setae on the elytra, but being pressed flat amongst the scales they are inconspicuous.

Emplesis nigriclava, n. sp.

♂. Black, antennae (except club) and tarsi reddish. Densely clothed with dark-brown and stramineous scales, becoming whitish on under parts and snowy on scutellum.

Rostrum the length of prothorax, slightly curved, parallel-sided; with fine ridges alternated with rows of squamiferous punctures from base to insertion of antennae (at apical two-fifths) beyond which the punctures are crowded and naked. Prothorax moderately transverse, sides rather strongly rounded. Elytra comparatively wide, base gently trisinuate, sides nowhere quite parallel. Abdomen with a wide depression on first and second segments, continued on to metasternum and feebly on to third and fourth, fifth about as long as second and third combined. Legs stout, femora scarcely grooved. Length, 3·5-4 mm.

♀. Differs in having the rostrum considerably longer, thinner, strongly curved, shining throughout, rows of punctures faint behind antennae (these median) and not squamiferous, abdomen with a smaller and shallower depression and fifth segment smaller.

Victoria: Gisborne (A. H. Elston from G. Lyell). New South Wales: Forest Reefs (A. M. Lea). Type, I. 16318.

An obscurely tessellated species, with the black rostrum club and under surface of *E. monticola,* but with a wide median space on the pronotum clothed with dark scales, conspicuously bounded on each side by a patch of pale ones; the elytra also have a fairly distinct, interrupted, pale fascia (sometimes reduced to isolated spots) crowning the summit of the apical slope. At first glance it is somewhat like the Tasmanian variety of *E. bituberculata,* but the abdomen is non-tuberculate and the club is black. The elytral setae are numerous but distinct only from the sides.

Emplesis interrupta, n. sp.

♂. Reddish-brown, metasternum darker. Densely clothed with dingy stramineous scales becoming whitish on under parts and snowy on scutellum.

Rostrum the length of prothorax, slightly curved, parallel-sided, with fine ridges alternated with rows of squamiferous punctures on basal half, apical half with naked punctures. Antennae inserted two-fifths from apex of rostrum. Prothorax moderately transverse, sides well rounded. Elytra rather thin, base not trisinuate, parallel-sided to beyond the middle. Two basal segments of abdomen shallowly depressed in middle, fifth as long as second and third combined. Length, 2·5-3 mm.

♀. Differs in having the rostrum longer, thinner, moderately curved, punctures very feeble, clothed only at extreme base, antennae inserted in middle of rostrum and abdomen gently convex with the fifth segment shorter.

Victoria: Birchip (J. C. Goudie, No. 217).

A tessellated species with markings faintly suggestive of *E. dorsalis.* On the elytra there is a fairly large but much interrupted dark patch that is terminated

just below the summit of the apical slope by a fascia of paler scales than elsewhere; on the pronotum there are three dark longitudinal markings, but only the median one is complete, the rest of its surface has a speckled appearance due to setae; all the setae on the upper surface are sub-depressed. On the male the metasternum is black, on two females it is scarcely darker than the adjacent parts.

Emplesis medfasciata, n. sp.

♂. Reddish-castaneous. Densely clothed with rusty-brown scales becoming paler on under parts, elytra with a conspicuous black median fascia, beneath which the derm is also darker than the adjacent parts.

Rostrum distinctly longer than prothorax, moderately curved, parallel-sided, with distinct ridges alternated with rows of squamiferous punctures to apical fourth, where the antennae are inserted, beyond which there are no ridges and the punctures are naked. Prothorax strongly transverse, sides moderately rounded. Elytra moderately robust, base distinctly trisinuate, parallel-sided to beyond the middle. Abdomen depressed along middle, the depression continued on to metasternum but faint on third and fourth segments, these unusually short, fifth slightly longer than second to fourth combined. Femora scarcely grooved; front tibiae longer and more curved than usual, the hind ones with a distinct swelling in middle of under surface. Length, 4·5-5 mm.

♀. Differs in having the rostrum longer (fully twice the length of prothorax), strongly curved, thinner, punctures sparse and small, the seriate ones smaller and naked; antennae inserted in middle of rostrum; abdomen flat along middle, third and fourth segments of normal size and the fifth very little longer than second; and tibiae normal although somewhat longer than usual.

South Australia: Lucindale (B. A. Feuerheerdt and F. Secker), Mount Lofty Ranges (S. H. Curnow), Kangaroo Island. Type, I. 16259.

An unusually distinct species with a conspicuous black median fascia occasionally broken up into irregular spots, beyond which the surface is faintly tessellated, due more to alterations in density of clothing than to colour. The unusually long and curved rostrum of the female passes well beyond the metasternum; the abdomen and tibiae of the male are also distinctive. On some specimens the head and parts of the under surface are infuscated. At the apex of the abdomen of the male there are two bristles, much as on many species of *Melanterius* and *Lybaeba*.

Emplesis costirostris, n. sp.

♂. Dark piceous-brown, some parts almost black, antennae and tarsi paler. Densely clothed with rusty-brown, ochreous, blackish and white scales; the under parts with sparser stramineous ones.

Rostrum the length of prothorax, moderately curved, parallel-sided, with seven distinct ridges alternated with rows of punctures to antennae (at apical two-fifths), beyond which the punctures are crowded and narrow. Prothorax moderately transverse, sides strongly rounded. Elytra elongate-subcordate, sides nowhere quite parallel. Two basal segments of abdomen feebly depressed in middle, fifth slightly longer than second and third combined. Length, 4-5·5 mm.

♀. Differs in having the rostrum slightly longer, abdomen gently convex, and fifth segment slightly shorter than second and third combined.

South Australia: Mount Lofty Ranges (S. H. Curnow and A. H. Elston), Port Lincoln (Rev. T. Blackburn). Type, I. 16260.

At first glance the derm beneath the scales appears to be black. On the pronotum the scales are irregularly intermingled; on the elytra there is a fairly large dark patch, sharply limited at the summit of the apical slope by an ochreous or rusty-red patch, the front edge of which is biarcuate, the dark patch is vague elsewhere and has scattered white specks on it; there is also a fairly large black

patch on each side; on the head the clothing is denser and paler between the eyes than elsewhere. The sexes are less defined than usual in *Emplesis;* two specimens with a slight depression on the abdomen are evidently males, the others on which it is gently convex are evidently females, but they have the rostrum very little longer, quite as sharply ridged, and the insertion of antennae almost the same; on both sexes the rostrum is squamose only near the base. The species is about the size of the preceding one, but the blackish patch is more posterior, and the front tibiae are not sub-falcate, are considerably shorter, and the hind ones are simple. It is also somewhat like *E. microsticta* in general appearance, but the rostrum is shorter, the antennae are inserted less close to the apex, and the apical clothing of elytra is different.

A female from Lucindale (B. A. Feuerheerdt) evidently belongs to the species; it differs from the others in being smaller, prothorax quite black, with black and white scales only, and the black patch on the elytra sharply defined throughout and sub-triangular in shape.

Emplesis interocularis, n. sp.

♀. Dark reddish-brown, antennae and rostrum somewhat paler. Densely clothed with pale dingy-brown scales, tessellated with paler and sooty spots, and not much paler on under parts than on upper ones; head bifasciculate between eyes.

Rostrum very long (about twice the length of prothorax), thin, strongly curved, basal fifth squamose, elsewhere with minute but fairly sharp punctures. Antennae inserted slightly nearer base than apex of rostrum. Prothorax strongly transverse, sides feebly rounded but suddenly narrowed at apex. Elytra rather narrow, sides nowhere quite parallel, base distinctly trisinuate. Abdomen with a slight depression common to first and second segments, fifth scarcely longer than second. Length, 3·5 mm.

South Australia: Mount Lofty Ranges (N. B. Tindale). Type (unique), I. 16261.

The species of *Emplesis* that are crested between the eyes appear to have females that are quite as distinct as their males, so the type of this species was described without hesitation. It is slightly longer than *E. tuberculifrons,* and the tessellation is somewhat different, the rostrum longer and strongly curved. The female of *E. scolopax,* as identified by Blackburn, has a considerably shorter and much less curved rostrum. The club is slightly paler than the rest of the antennae. The paler and darker spots are more conspicuous on the three first interstices on each elytron than on the others; on the pronotum there is a continuous sooty median line, and two shorter sub-triangular marks touching the base. The clothing of the under parts is denser and darker than usual and normally conceals the punctures; even on the scutellum the scales are not distinctly whitish.

Emplesis illota, n. sp.

♂. Reddish-brown. Densely clothed with stramineous-brown scales, with numerous dark spots, under parts with whitish clothing.

Rostrum slightly longer than prothorax, moderately curved, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical two-fifths (where the antennae are inserted), beyond which there are numerous naked punctures. Prothorax moderately transverse, sides strongly rounded. Elytra rather narrow, for a short distance parallel-sided, base trisinuate. Abdomen with a shallow depression on first and second segments, fifth distinctly shorter than second and third combined. Femora not grooved, tibiae unusually short. Length, 2·25-2·75 mm.

♀. Differs in having the rostrum much longer, thinner, strongly curved, glabrous, with minute punctures, antennae inserted slightly nearer base than apex, and abdomen evenly convex.

South Australia: Murray Bridge (A. M. Lea). Type, I. 16265.

A narrow dingy species, the dark spots on the elytra more or less conjoined to form several V's, but not as on *E. suturalis,* which is a larger species, with the rostrum of the female shorter and much less strongly curved; some narrow spots are slightly paler than the adjacent parts, but at first glance the tessellation of the elytra appears to be due to two shades only; on the pronotum there are three inconspicuous dark marks, of which the median one only is continuous from base to apex.

Emplesis grisea, n. sp.

♂. Reddish-brown. Densely clothed with slaty-grey scales feebly mottled or tessellated with darker spots; under parts with paler and sparser clothing.

Rostrum long, almost straight, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), beyond which the punctures are dense and naked. Prothorax moderately transverse, sides gently rounded. Elytra rather narrow, parallel-sided to about the middle, base feebly trisinuate. Abdomen with a wide, shallow and almost continuous depression, but very faint on third and fourth segments, fifth scarcely longer than second. Hind femora very feebly grooved. Length, 2·5-3·5 mm.

♀. Differs in having the rostrum thinner and much longer (almost twice the length of prothorax), slightly more curved, bright castaneous, glabrous, almost impunctate, antennae inserted slightly nearer its base than apex, prothorax more transverse, elytra less parallel-sided, and abdomen flat along middle.

South Australia: Lucindale (B. A. Feuerheerdt), Yorke Peninsula (Capt. S. A. White), Port Lincoln (Rev. T. Blackburn and A. M. Lea). Type, I. 16266.

The clothing of the upper surface is sometimes almost uniformly greyish, on some specimens the paler scales form feeble V's; on the pronotum the median line is usually very faint, and there may be but one dark mark on each side at the base, but on many specimens the sides are rather distinctly mottled. Blackburn had specimens of this species mixed with *E. scolopax,* and in a note on that species remarked "the well-defined fascicles of coarse scales . . . these, however, are very easily rubbed off." Many of the specimens before me are quite evidently in perfect condition, and although the scales between their eyes may be regarded as forming a feebly depressed pad, this is very different from the erect fascicles of *scolopax;* the general clothing is also of a more slaty-grey colour. The general appearance is sometimes much as on *E. cylindrirostris,* but the rostrum of both sexes is longer and less straight. *E. macrostyla* (from Western Australia) has rostrum of the male (the only sex known) and abdomen somewhat similar, but its tessellation is of the usual kind. On an occasional female (usually immature) there is a slight sprinkling of scales on the basal half of the rostrum.

Emplesis invenusta, n. sp.

♂. Dark brown, antennae paler, metasternum and abdomen black. Densely clothed with slaty-grey scales, obscurely mottled with darker ones, becoming whitish on under parts; briefly bifasciculate between eyes.

Rostrum scarcely longer than prothorax, parallel-sided, slightly curved, with fine ridges alternated with rows of squamiferous punctures to apical two-fifths (where the antennae are inserted), beyond which the punctures are rather dense and naked. Prothorax moderately transverse, sides strongly rounded. Elytra rather narrow, nowhere quite parallel-sided, base slightly trisinuate. Two basal segments of abdomen feebly depressed along middle, fifth distinctly shorter than second and third combined. Femora very feebly grooved. Length, 2·5 mm.

South Australia: Karoonda to Peebinga (G. E. H. Wright), Murray River (H. S. Cope). Type, I. 16254.

In general appearance like *E. squamirostris* on a reduced scale, but rostrum slightly shorter and more curved, clothed only to insertion of antennae, its base feebly fasciculate instead of with a distinct swelling, and legs and rostrum entirely reddish. It is also somewhat like the preceding species, but the rostrum is shorter, the abdomen is more faintly depressed, and, with the metasternum, is black. The tessellation of the elytra and three marks on the pronotum are faint on both specimens under examination.

Emplesis intricata, n. sp.

Dark brown, rostrum, antennae and legs somewhat paler, metasternum almost black. Densely clothed with slaty-grey and brown scales, becoming white on scutellum and under parts.

Rostrum scarcely the length of prothorax, slightly diminishing in width from base to insertion of antennae (slightly nearer apex than base), basal half with sculpture concealed by scales, apical half with numerous small punctures. Prothorax as long as basal width, sides moderately rounded. Elytra rather narrow, sides nowhere quite parallel, base almost truncate. Abdomen rather strongly convex, a narrow inconspicuous impression along middle, fifth segment no longer than second, and with two minute apical bristles. Length, 3 mm.

South Australia: Kangaroo Island. Type (unique), I. 16268.

The tessellation of the elytra is fairly strong, although the scales are of but two colours; on the pronotum there are five longitudinal marks (of which the outer ones are interrupted) and a transverse one, but all are more or less connected. The colours of the scales are much as in *E. grisea* and *E. cylindrirostris*, but the pattern is not the same and the rostrum is stouter and wider at the base. The sex of the type is doubtful, but it is probably a male.

Emplesis apiciventris, n. sp.

♂. Reddish-castaneous; scutellum, a fairly large patch on elytra, metasternum and base of abdomen black. Densely clothed with rusty and stramineous slightly variegated scales, becoming sparser and whitish on under parts.

Rostrum about the length of prothorax, feebly curved, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with crowded naked punctures. Prothorax about as long as the basal width, sides strongly rounded. Elytra narrow, almost parallel-sided to beyond the middle, base almost truncate. Under surface with a depression from middle of metasternum to apex of abdomen; fifth segment of the latter almost as long as second to fourth combined. Femora feebly grooved. Length, 2·5 mm.

South Australia: Mount Lofty Ranges (S. H. Curnow). Type (unique), I. 16269.

The black patch is somewhat oval in shape, extends across three interstices on each elytron from the base to about the middle, but is in part interrupted by the suture; it is somewhat like that of *E. ovalisticta* in miniature. There are two slight pale V's on the elytra; one partly on the apical slope, the other (a very feeble one) on the black patch; on the pronotum the mottling is very feeble. The median ridge of the rostrum, although very narrow, is traceable almost to the apex.

Emplesis alternata, n. sp.

♂. Dull reddish-brown. Densely clothed with dull stramineous and brownish scales, becoming whitish on under parts.

Rostrum slightly shorter than prothorax, parallel-sided, gently curved, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front of which are numerous naked punctures. Prothorax moderately transverse, parallel-sided to near apex, which is sub-tubular. Elytra thin, almost parallel-sided to beyond the middle, base feebly trisinuate. Abdomen with a fairly wide depression on two basal segments, fifth almost as long as second and third combined. Length, 3 mm.

South Australia: Gawler (J. Faust's No. 499 from Blackburn's Collection). Type (unique), I. 16270.

The markings are somewhat as on *E. lithostrota* and *E. cylindrirostris,* but the rostrum is differently curved and is shorter than on most species of the genus. The third interstice has four dark spots conspicuously alternated with pale ones, on the rest of the elytra the tessellation is less distinct; on the pronotum there are three longitudinal marks of which only the median one is continuous, but it is rather ill-defined.

Emplesis sublecta, n. sp.

♂. Reddish-brown, suture black except close to base. Densely clothed with slaty-grey or stramineous scales, and with brownish spots, becoming whitish on under parts.

Rostrum feebly curved, no longer than prothorax, parallel-sided, basal half squamose, apical half with small naked punctures. Antennae inserted two-fifths from apex of rostrum. Prothorax as long as the basal width, sides moderately rounded. Elytra parallel-sided to beyond the middle, base feebly trisinuate. Abdomen flattened along middle, fifth segment slightly longer than second. Length, 2·25-2·5 mm.

♀. Differs in having the rostrum slightly longer than the prothorax, thinner, cylindrical and polished castaneous, antennae inserted distinctly nearer base than apex, prothorax slightly wider, and apical segment of abdomen shorter.

South Australia: Owieandana (H. M. Hale and N. B. Tindale), Quorn (A. H. Elston). Type, I. 16273.

A small species distinct by the black suture. The tessellation of the elytra is rather faint, but there are two or three white spots on the suture, on the pronotum there is a faint median line and two short basal vittae. The convexity of the abdomen scarcely differs sexually. Two specimens, sexes, from the Murray River (Elston), differ from the types in having a black fascia extending across four or five interstices on each elytron at the summit of the apical slope, and with five longitudinal marks on the pronotum, of which, however, each outer one is very feeble.

Emplesis miscella, n. sp.

♂. Reddish-brown. Densely clothed with pale slaty-grey scales variegated with brown, and becoming white on under parts.

Rostrum the length of prothorax, almost straight, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front of which are small naked punctures. Prothorax as long as wide, sides gently rounded. Elytra narrow, nowhere quite parallel-sided, base faintly incurved to scutellum but not trisinuate. Two basal segments of abdomen slightly depressed along middle, fifth slightly longer than second. Hind femora feebly grooved. Length, 2·5 mm.

South Australia: Hughes (A. M. Lea). Type (unique), I. 16276.

About the size of the preceding species and with similarly coloured scales, although on a different pattern. The legs are shorter, and the prothorax longer than usual. There are two large dark sutural spots: one before the middle, surrounded by short pale spots, and a smaller one at summit of apical slope; on the rest of the elytra the tessellation is almost regular; but from some directions

there appear to be three pale irregular fasciae. On the pronotum the dark markings consist of a narrow median line, and two transverse series of four spots: the first slightly nearer apex than base, the second basal, with the inner spot much larger than the others. The setae of the upper surface are all depressed, and so are not distinct from the sides.

Emplesis rectirostris, n. sp.

♀. Reddish-brown, rostrum and antennae paler, suture, a spot on each elytron, metasternum and most of abdomen black. Moderately clothed with scales similar in colour to the derm, with stramineous tessellation; on under parts becoming white.

Rostrum long (almost twice the length of prothorax), thin, cylindrical, almost straight, polished, glabrous and with sparse, scarcely visible punctures. Antennae inserted slightly nearer base than apex of rostrum. Prothorax slightly wider than long, sides moderately rounded. Elytra elongate-subcordate, sides nowhere quite parallel, base slightly trisinuate. Fifth segment of abdomen the length of third. Length, 2·75-3 mm.

South Australia: Mount Lofty Ranges (N. B. Tindale), Lucindale (B. A. Feuerheerdt). Type, I. 16277.

A prettily marked species with an unusually long and practically straight rostrum. It is slightly padded between the eyes, not fasciculate as in *E. scolopax*. The rostrum is almost as long as in the females of *E. filirostris* and *E. dispar*. The black spot on each elytron is sub-lateral, postmedian, and varies in size and intensity. The darker scales on the elytra are so similar to the derm on which they rest, that the only distinct ones are those forming narrow stramineous spots, of which several are compacted to form irregular fasciae. On the pronotum the stramineous scales are in irregular patches on the sides, and form two small spots on the disc.

Emplesis inscripta, n. sp.

♂. Pale reddish-castaneous, club, metasternum and most of abdomen black. Moderately clothed with inconspicuous brown scales, conspicuously variegated with stramineous spots; under parts with white scales.

Rostrum about the length of prothorax, parallel-sided, slightly curved; with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), beyond which the punctures are dense and naked. Prothorax moderately transverse, sides rather strongly rounded. Elytra narrow, base slightly trisinuate. Abdomen with a large depression on two basal segments, continued on to metasternum, fifth slightly longer than second. Legs short and stout. Length, 2-2·25 mm.

♀. Differs in having the rostrum longer, thinner, more curved, shining, and sparsely clothed only near base, antennae inserted almost in exact middle, abdomen more convex, the depression on the basal segments smaller and shallower, and the third and fourth slightly larger.

Tasmania: Hobart (Rev. T. Blackburn). Type, I. 16256.

About the size of *E. impotens* but tessellation on a somewhat different plan, and more of under surface black. *E. cyphirhina* has very different tessellation. In general appearance it is like *E. apiciventris,* but the club is black. The stramineous spots are unusually short and distinct on the elytra, and in places are compacted to form feeble fasciae; on the pronotum the paler scales are so placed as to form an M, or three V's, of which the outer two are inverted. A male from Mole Creek (A. M. Lea) evidently belongs to this species, but it is immature; it is almost flavous, with only the club and sutures of metasternal episterna black.

Emplesis leucophaea, n. sp.

♂. Reddish-brown, suture and club black. Densely clothed with whitish-grey scales, faintly tessellated on upper surface, becoming white on under parts.

Rostrum the length of prothorax, comparatively wide, parallel-sided, moderately curved, with fine ridges (the median one continuous to apex), alternated with rows of squamiferous punctures, becoming naked on apical half. Antennae inserted two-fifths from apex of rostrum. Prothorax slightly transverse, sides moderately rounded. Elytra not much wider than widest part of prothorax, parallel-sided to beyond the middle, base feebly trisinuate. Abdomen with a large depression on two basal segments, continued on to metasternum, fifth almost as long as second and third combined. Length, 1·75-2 mm.

♀. Differs in having the rostrum longer, thinner (but not quite cylindrical), ridges and squamiferous punctures on basal fourth only, antennae inserted not as close to apex (but distinctly nearer apex than base), abdomen evenly and strongly convex, and third and fourth segments longer.

Tasmania: Strahan (H. J. Carter and A. M. Lea), Karoola (Aug. Simson), Burnie, Ulverstone, Nubeena, Huon River (Lea). Type, I. 16321.

A minute species, with a distinct suggestion of pale and very small *Orthorhinus cylindrirostris*. It is one of the very few in which the antennae of the female are inserted nearer the apex than the base of rostrum. The elytral clothing is so dense that the black of the suture is often concealed; the tessellation is faint, and more distinct on and near the suture than elsewhere; on several specimens the clothing appears to be almost uniformly greyish, as on *E. niveiceps*, and allied species.

Emplesis pallida, n. sp.

♂. Reddish-castaneous. Densely clothed with greyish-white scales, faintly tessellated on upper surface.

Rostrum the length of prothorax, gently curved, parallel-sided, basal half with fine ridges alternated with rows of squamiferous punctures, in front with naked punctures. Antennae inserted about two-fifths from apex of rostrum. Prothorax moderately transverse, sides rather strongly rounded in front. Elytra narrow, almost parallel-sided to beyond the middle, base scarcely trisinuate. Abdomen with a wide shallow depression on two basal segments, fifth almost as long as second and third combined. Hind femora very feebly grooved. Length, 2·25-2·5 mm.

♀. Differs in having the rostrum longer, thinner, more strongly curved, cylindrical, glabrous to base, with minute punctures; antennae inserted nearer base than apex; abdomen gently and evenly convex, and fifth segment shorter.

North-western Australia: Fortescue River and Roebourne (W. D. Dodd). Type, I. 16257.

A small, pale, faintly tessellated species, approaching *Thechia* in appearance. In general appearance it is strikingly close to the specimens commented upon as probably being *E. interioris*, but the abdomen of the male is normal. On several specimens the metasternum appears to be slightly infuscated. The darker spots on the elytra are short and inconspicuous, on the pronotum a median line and two sub-triangular basal spots are just discernible.

Two specimens, sexes, from Cue (H. W. Brown), possibly belong to this species; the male is scarcely distinguishable from the type, but the female has the rostrum slightly more curved, and the elytra with a pale and two dark fasciae, composed of spots, on and about the summit of the apical slope.

Emplesis sordida, n. sp.

♂. Dark reddish-brown, antennae and parts of tarsi paler. Densely clothed with dull stramineous scales, and with numerous inconspicuous brown spots; under parts with whitish clothing.

Rostrum slightly longer than prothorax, gently curved, parallel-sided; with fine ridges, alternated with rows of punctures to apical third (where the antennae are inserted), in front with numerous small punctures, basal half squamose. Prothorax moderately transverse, sides rather strongly rounded. Elytra elongate, almost parallel-sided to beyond the middle, base trisinuate. Abdomen with a shallow continuous depression but scarcely traceable on third and fourth segments, fifth slightly longer than second and third combined. Length, 4·5-5 mm.

♀. Differs in being slightly wider, rostrum longer (almost twice the length of prothorax), slightly more curved, thinner, polished castaneous, glabrous and almost impunctate, antennae inserted nearer base than apex and abdomen almost evenly convex.

Western Australia: Swan River (J. Clark and A. M. Lea). Type, I. 16322.

A large dingy species, slightly padded but not fasciculate between the eyes. There are from three to five brown spots on most of the elytral interstices, but the tessellation is usually inconspicuous. In some lights faint depressions may be seen on the abdomen of the female. It is larger and wider than *E. filirostris*, rostrum shorter and clothing duller; *E. dispar* is thinner, with longer and straighter rostrum (both sexes); *E. ignobilis* (fresh specimens) has clothing of a more reddish tone and somewhat shorter rostrum (both sexes); *E. femoralis* is smaller and narrower.

Emplesis tibialis, n. sp.

♂. Pale reddish-castaneous, under surface usually darker. Moderately clothed with stramineous scales; with numerous small brown spots on elytra, and a median line and two basal spots on pronotum; under parts with uniform whitish clothing.

Rostrum slightly longer than prothorax, moderately curved, parallel-sided; with fine ridges alternated with rows of squamiferous punctures to apical fourth (where the antennae are inserted), beyond which the punctures are small and naked. Prothorax about as long as the basal width, strongly narrowed in front. Elytra elongate-subcordate, base not trisinuate, sides nowhere quite parallel; seriate punctures larger than usual. Abdomen with a wide shallow depression on two basal segments, and another on fifth; the latter segment as long as second and third combined. Legs longer than usual, front tibiae thin, with an acute projection on middle of lower surface. Length, 2·5-3·5 mm.

♀. Differs in being somewhat stouter; rostrum longer, thinner, more curved, ridges and seriate punctures much finer, glabrous, prothorax more transverse, abdomen evenly convex, and front tibiae unarmed.

Tasmania: Strahan, West Tamar (Aug. Simson), Hobart (C. E. Cole and A. M. Lea). Victoria: Dividing Range (Rev. T. Blackburn), Somerville (Lea). South Australia: Adelaide. Type, I. 16278.

A slightly tessellated species readily distinguished from all others of the genus (except the following one) by the armed front tibiae of the male, those of the female, although not armed, are decidedly longer than on females of most species.

Emplesis subtibialis, n. sp.

♂. Reddish-brown, club somewhat infuscated. Densely clothed with pale slaty-grey or stramineous scales, more or less variegated, becoming white on under parts; the elytra with rows of erect setae on the alternate interstices.

Rostrum slightly longer than prothorax, parallel-sided, gently curved, sculpture concealed by clothing to apical fourth (where the antennae are inserted),

in front with naked punctures. Prothorax slightly transverse, sides moderately rounded. Elytra sub-oblong, base scarcely trisinuate. Abdomen with a very shallow depression on first and second segments, fifth as long as second and third combined. Legs of moderate length, front tibiae with an acute projection on lower surface two-fifths from apex. Length, 2-2·5 mm.

♀. Differs in having rostrum longer, thinner, more curved, clothed only on basal third, elsewhere minutely punctate, antennae inserted two-fifths from apex, abdomen evenly convex, fifth segment the length of second and front tibiae simple.

Tasmania: Ulverstone and King Island (A. M. Lea).

The front tibiae of the male are armed, but the projection is nearer the apex than on the preceding species, the tibiae themselves (both sexes) are shorter and the clothing is denser and usually conceals the seriate elytral punctures. The clothing is not exactly alike on any two of the six specimens taken; on three of them it is opaque and slightly tessellated; on the others many of the scales, especially on the head, have a slight golden gloss; on the type there are three fasciae of dark spots, of which the widest is curved and crowns the apical slope, a sub-apical one is less distinct and a postmedian one still less so; on the others the dark spots are sparser and more scattered. On two specimens the metasternum is darker than the abdomen. There are some erect setae on the rostrum of the male.

Emplesis obliqua, n. sp.

♂. Dark brown, legs paler, suture, metasternum and abdomen black. Densely clothed with scales of several colours, becoming white on under parts.

Rostrum the length of prothorax, parallel-sided, moderately curved; with fine ridges alternated with rows of punctures to apical third (where the antennae are inserted), with dense punctures in front, densely clothed only on basal fourth. Prothorax slightly transverse, sides strongly rounded. Elytra parallel-sided to beyond the middle, base feebly trisinuate; seriate punctures larger than usual. Abdomen with a large, sharply defined depression on two basal segments, fifth very little longer than second. Length, 2·25-3 mm.

♀. Differs in having the rostrum longer, thinner, more curved, seriate punctures smaller and for a shorter distance, glabrous throughout, antennae inserted only slightly nearer apex than base; abdomen evenly convex, and fifth segment slightly shorter than second.

Tasmania: Launceston (Aug. Simson), Mount Wellington (A. M. Lea). Victoria: Yarra River (C. French, sen.), Noble Park in October (F. E. Wilson), Wonthaggi (T. G. Sloane), Warburton in October (C. Oke). South Australia: Lucindale (F. Secker and B. A. Feuerheerdt), Mount Lofty Ranges (S. H. Curnow), Adelaide (Rev. T. Blackburn). North Queensland (Blackburn's Collection). Type, I. 16280.

A conspicuously marked species with oblique fasciae suggestive of *Ephrycus obliquus;* the elytral markings are somewhat like those of *Storeus captiosus,* but that species has dentate femora and appendiculate claws. There are two rather large blackish patches on each side of the elytra, with a conspicuous white patch between, the white patch sometimes obliquely connected with its fellow on the suture, just below the summit of the apical slope; much of the elytral clothing is of a rusty-red colour, on the suture it is alternately black and white. On the pronotum most of the clothing is whitish, with two fairly large black spots on each side of the middle, and some smaller ones on the sides; but often the clothing on the median half is almost entirely black; on the head there is usually a dark median spot and snowy scales between the eyes; on the scutellum also the scales are snowy. On slight abrasion, however, many of the markings are obscured. There are numerous sub-erect setae on the elytra, some of the white ones being

very distinct. On two small specimens, from Mounts Wellington and Lofty, the elytral markings are less sharply defined, and the clothing of the pronotum is almost entirely stramineous and whitish; their club is pale. One from Wonthaggi, with similar clothing, has the club black, but the metasternum and abdomen no darker than the legs.

Emplesis albifrons, n. sp.

♂. Dark reddish-brown, suture and sides of elytra and under surface black or blackish; with slaty-white and dark-brown scales, becoming white on under parts.

Rostrum slightly longer than prothorax, moderately curved, parallel-sided, with fine ridges alternated with rows of squamiferous punctures on basal half, punctures small and naked elsewhere. Antennae inserted two-fifths from apex of rostrum. Prothorax moderately transverse, sides rather suddenly narrowed to apex. Elytra thin, base bilobed, sides almost parallel to beyond the middle. Two basal segments of abdomen slightly depressed in middle, fifth almost as long as second and third combined. Hind femora very feebly grooved. Length, 2-2·25 mm.

♀. Differs in having the rostrum longer, thinner, more curved, shining and glabrous throughout, antennae inserted nearer base than apex, and abdomen evenly convex, with the fifth segment shorter.

South Australia: Port Lincoln (Rev. T. Blackburn and A. M. Lea), Woodchester (E. Ashby), Murray Bridge (Lea). Type, I. 16283.

A minute species with somewhat tessellated markings and usually a fairly large dark patch on the basal half of elytra. The dark sutural part is clothed with dark scales, but about the middle is traversed by a white fascia, and there are a few other whitish scales on it; on the rest of the elytra the clothing is whitish with sparse and small brown spots, on the pronotum there are sometimes three dark patches, of which the two outer ones are short, or the three may be conjoined in front, or the clothing may be pale only on the sides, or almost entirely pale. Most of the scales on the head are dark, but the interocular ones are snowy; on one female most of the cephalic scales are whitish, but even on this one the interocular patch is distinctly whiter.

Emplesis picta, n. sp.

♂. Black, parts of elytra, antennae (club excepted) and legs reddish. Densely clothed with white and black scales, the elytra in addition with some brownish ones, on under parts entirely white.

Rostrum about the length of prothorax, moderately curved, parallel-sided; with fine ridges, alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with fairly dense naked punctures. Prothorax almost as long as the basal width, sides strongly rounded. Elytra suboblong to near apex, base feebly bilobed. Two basal segments of abdomen with a shallow depression on which the clothing is finer than elsewhere, fifth slightly longer than third. Femora stout, all more or less distinctly grooved. Length, 2·5-2·75 mm.

♀. Differs in having the rostrum thinner and paler but scarcely longer, clothed only near base, but seriate punctures distinct to antennae, these inserted about two-fifths from apex, club paler, abdomen evenly convex, fifth segment smaller, and femora less stout.

Tasmania: Hobart (A. M. Lea).

A conspicuously marked species with sexual differences of the rostrum less pronounced than usual. The reddish parts of the elytra are not sharply defined and are mostly clothed with white and brownish scales. On the pronotum the scales are black, with a fairly large white patch on each side of the base, and two

small median spots. On the elytra there is a large black humeral patch (on each side dilated to cover the marginal fourth), a sub-oblong antemedian sutural patch and a large trilobed fascia crowning the apical slope, the white scales are interspersed with small dark spots scarcely distinguishable from the derm. The head of the male has been forced back and its base is concealed, but between the eyes and on the rostrum the scales are snowy; on the female the scales are black, with a median line and the interocular ones snowy.

Emplesis albifasciata, n. sp.

♀. Black, rostrum, funicle, scape, and parts of legs reddish. Densely clothed with black, rusty-brown and white scales, becoming snowy on under parts.

Rostrum thin, moderately curved, about the length of prothorax, with fine ridges alternated with rows of squamiferous punctures on basal half, elsewhere with naked punctures. Antennae inserted two-fifths from apex of rostrum. Prothorax slightly shorter than basal width, sides strongly rounded towards apex. Elytra rather wide, nowhere parallel-sided, base (except for incurvature at scutellum) truncate. Abdomen evenly convex, fifth segment scarcely longer than second. Femora feebly grooved. Length, 2·5 mm.

Victoria: Alps (Rev. T. Blackburn). Type (unique), I. 16284.

A prettily marked species, allied to the preceding one, with similar clothing on the pronotum, and the rostrum sculptured as its female, but elytra decidedly wider, the black patches different, and with a conspicuous white fascia. On the pronotum the scales are black, with a distinct white patch on each side of the base, and a few scales scattered singly, on the elytra there is a complete white median fascia, wide and angular about the suture, and running obliquely to each side slightly in advance of the middle; there is also a small white sub-apical spot on the suture, and some whitish scales at the base; there is a large black spot on each side behind the fascia and some inconspicuous blackish scales about the shoulders and basal half, the rest of the elytra having rusty-brown scales. On the head the scales are black, becoming white between and close behind the eyes.

Emplesis pictipennis, n. sp.

Reddish-brown, suture (narrowly), parts of metasternum, base of abdomen, and club black. Clothed with stramineous or somewhat darker scales, with whitish markings on upper surface, under parts with entirely whitish scales.

Rostrum thin, slightly longer than prothorax, moderately curved, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with distinct naked punctures. Prothorax as long as wide, apex about half the width of base. Elytra rather narrow, base bilobed. Fifth segment of abdomen slightly longer than second and third combined. Length, 2·25 mm.

Western Australia: Mullewa (W. D. Dodd). Type (unique), I. 16285.

Allowing for the notches at the junction of the prothorax and elytra the outlines are elongate-elliptic, much as those of *E. bellulus*, but the markings are not the same and the abdomen is almost entirely pale. The general appearance is as some specimens of *Storeus variabilis*, but the femora are edentate. On the pronotum most of the scales are obscurely coloured; on the elytra there is a distinct white semi-circle about the scutellum, and a bisinuate fascia crowning the apical slope, elsewhere the white scales form rather feeble spots. The sex of the type is doubtful; the rostrum is thinner than is usual in males, but its sculpture and clothing appear masculine; the two basal segments of abdomen are not concave in the middle, but the apical segment is longer and the third and fourth shorter than usual in females.

Emplesis lilliputana, n. sp.

♂. Pale reddish-castaneous. Moderately clothed with stramineous and brownish scales, becoming white on under parts.

Rostrum rather thin, slightly longer than prothorax, moderately curved, parallel-sided; with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted); in front with numerous small, naked punctures. Prothorax as long as greatest width, sides strongly rounded. Elytra with sides rounded throughout, base slightly bilobed and much wider than prothorax. Abdomen with a feeble depression on two basal segments, fifth almost as long as second and third combined. Length, 1·75 mm.

Queensland: Mount Tambourine (A. M. Lea). Type (unique), I. 16288.

A minute, sub-tessellated species, with base of elytra much wider than base of prothorax. The clothing of the upper surface is not of conspicuously contrasted colours; on the pronotum it is mostly stramineous, but there is an ill-defined whitish spot on each side of the base; on the elytra there are two whitish spots, adjacent to those on the pronotum, the clothing on the apical half is mostly dark, with a few pale spots interspersed. Setae are apparently absent from the upper surface, and the scales are so closely pressed to the derm that at first it appears to be stained rather than clothed.

Emplesis angusta, n. sp.

♂. Reddish-brown, suture blackish. Densely clothed with whitish and stramineous scales and with a few dark spots; under parts sparser and white.

Rostrum scarcely as long as prothorax, moderately curved, parallel-sided; with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with sharply defined naked punctures. Prothorax almost as long as wide, sides moderately rounded. Elytra narrow, sides feebly rounded, base almost truncate. Abdomen with a fairly large depresssion on two basal segments, fifth slightly longer than second and third combined. Length, 2 mm.

♀. Differs in having the rostrum slightly longer than prothorax, with ridges and seriate punctures on basal half, and clothed only on basal fourth, antennae inserted two-fifths from apex, prothorax more transverse, and abdomen evenly convex, with the fifth segment scarcely longer than the second.

South Australia: Lucindale (B. A. Feuerheerdt). Type, I. 16287.

A minute, sub-tessellated species with a pale V-shaped patch on elytra outlining a rather narrow dark triangle about scutellum; on the male the V is extended to an M; behind the first V there are remnants of a second, and then a few scattered spots; on the pronotum there are two sub-triangular dark basal spots and a feeble median line. The outlines (allowing for slight notches at the junction of the prothorax and elytra) are narrowly elliptic. To a slight extent it resembles *E. parvula*, but the markings are on a different plan.

Emplesis trisinuata, n. sp.

♂. Reddish-brown, metasternum infuscated. Densely clothed with stramineous, white and sooty scales, becoming sparser and uniformly whitish on under parts.

Rostrum the length of prothorax, slightly curved, parallel-sided, with fine ridges alternated with rows of punctures (squamiferous on basal third) to insertion of antennae (at apical two-fifths), in front with sharply defined naked punctures. Prothorax about as long as wide, base and apex sub-equal. Elytra rather narrow, sides nowhere quite parallel, base distinctly trisinuate. Abdomen with a small depression on two basal segments, fifth almost as long as second and third combined. Length, 2·5-2·75 mm.

♀. Differs in having the rostrum conspicuously longer, thinner, less curved, ridges and rows of punctures less pronounced and for a shorter distance, antennae inserted almost in exact middle of rostrum, prothorax slightly transverse, and abdomen evenly convex, with the fifth segment no longer than third.

South Australia: Lucindale (B. A. Feuerheerdt). Type, I. 16286.

There is a large dark patch on the elytra extending from the base to about the middle, and across two or three interstices on each side of the suture, posteriorly it is bounded by a curved row of white spots, then on the suture there is a small black spot, followed by a white one, then a black one, then to the apex the sutural clothing is stramineous; there is a narrow angular blackish strip near each side, on the rest of the elytra the clothing is slightly tessellated. On the pronotum there is a sub-quadrate discal blackish patch, with the sides stramineous, but there are a few stramineous scales on the black patch, and some dark scales elsewhere. The dark elytral patch is about as large in proportion as on *E. ovalisticta*, but the species is much smaller and differs otherwise. In some respects it approaches *E. dorsalis*, but the abdomen is not black. A specimen from Quorn (Rev. T. Blackburn) probably belongs to the species, but the clothing on the apical fifth of elytra is black.

Emplesis basipennis, n. sp.

♂. Reddish-brown, metasternum slightly infuscated. Densely clothed with stramineous or rusty, and sooty-brown scales.

Rostrum the length of prothorax, moderately curved, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with dense, naked punctures. Prothorax about as long as wide, sides gently rounded. Elytra rather thin, nowhere quite parallel-sided, base gently and evenly arcuate. Two basal segments of abdomen flattened (not concave) along middle, fifth as long as second and third combined. Length, 2·75 mm.

South Australia: Adelaide (N. B. Tindale), Lucindale (F. Secker). Type, I. 16333.

A tessellated species at first glance apparently belonging to the preceding one or to *E. dorsalis;* from the former it is distinct by the rostrum slightly more curved, base of elytra gently and uniformly arched (except for the scutellum), with the large dorsal patch longer and more interrupted and the prothoracic markings different; the latter species has a somewhat shorter rostrum and the abdomen black. On the elytra the dark scales form a patch from the base to about one-fourth from the apex, where it is interrupted by a fascia of pale spots; it extends across four or five interstices on each elytron, but is not uniform, as there are many thin spots of pale scales, or single ones, giving the patch a mottled appearance; on the rest of the elytra the clothing is slightly tessellated. On the pronotum there is a thin median line of dark scales, then an irregular vitta, and then some fragments of others. The head is feebly padded between the eyes. On the scutellum and under parts the clothing is paler than elsewhere.

Emplesis setipennis, n. sp.

Pale reddish-brown, club infuscated. Densely clothed with pale, almost white scales, with darker markings, and with numerous sub-erect setae.

Rostrum thin, moderately curved, slightly longer than prothorax, with small naked punctures on apical half, basal half clothed. Antennae inserted two-fifths from apex of rostrum. Prothorax as long as wide, sides gently rounded. Elytra elongate-subcordate, base bilobed, sides nowhere quite parallel. Two basal segments of abdomen flattened along middle, fifth slightly longer than third. Length, 2 mm.

New South Wales: Illawarra (G. Compere). Unique.

A conspicuously setose species; brighter than *E. cryptorhyncha,* and with a large pale patch on each side of prothorax. On the elytra there are three fairly large dark spots: one median, one postmedian, and one sub-apical, the latter semi-double, elsewhere there are a few feeble spots. On the pronotum there is a large dark median patch extending from base to apex, but with numerous pale scales, the patch intensified by a dense strip of pale scales on each side. In some lights some of the scales, especially those near eyes, have a golden lustre. The setae are quite as numerous on the prothorax as on the elytra, but on the latter they are more conspicuous. Except for the notches at their junction the outlines of the prothorax and elytra are elongate-elliptic. The sex of the type is doubtful.

Emplesis cordipennis, n. sp.

♂. Flavo-castaneous, club infuscated; with stramineous and brownish scales irregularly intermingled on elytra, on pronotum the darker scales forming three feebly defined vittae.

Rostrum the length of prothorax, parallel-sided, moderately curved, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with distinct naked punctures. Prothorax almost as long as wide, sides moderately rounded. Elytra elongate-cordate, base bilobed. Two basal segments of abdomen with a feeble median depression, fifth slightly longer than second. Length, 1·75-2 mm.

♀. Differs in having the rostrum considerably longer, thinner, more curved, ridges and rows of squamiferous punctures confined to basal third, punctures elsewhere sparse and minute, antennae inserted just perceptibly nearer apex than base and abdomen evenly convex, with the fifth segment shorter.

New South Wales: Wollongong (A. M. Lea).

A minute species intermediate between the tessellated and *niveiceps* groups. It is about the size of *E. canaliculata,* and also has a dark club, but the clothing is less ashen, and the derm is paler; the suture on some specimens, however, is feebly infuscated. The darker clothing on the upper surface is scarcely different in colour from the derm on which it rests, and the spots of both colours are not sharply limited, as on so many of the tessellated species.

Emplesis nana, n. sp.

Reddish-brown, scutellum, metasternum and four basal segments of abdomen black. Densely clothed with greyish-white scales, variegated with brown; on under parts entirely white.

Rostrum thin, parallel-sided, slightly longer than prothorax, moderately curved; antennae inserted two-fifths from base, behind which the scales partly conceal fine ridges and rows of punctures. Prothorax slightly wider than long, sides moderately rounded. Elytra elongate-cordate, base bilobed, sides nowhere quite parallel. Abdomen moderately convex, fifth segment slightly longer than second. Length, 1·5 mm.

Queensland: Bundaberg (A. M. Lea). Type (unique), I. 16291.

A minute species of the size of *E. canaliculata,* but scutellum and most of under surface black and the club pale. The derm of the upper surface is almost entirely concealed by the clothing (which could hardly be regarded as tessellated), but the suture appears to be infuscated. On the elytra the dark scales form a very feeble V at the base, then remnants of a darker V, followed by remnants of a reversed V, and then a still fainter mark near the apex. On the pronotum three short vittae are indicated, but dark setae cause the surface to appear slightly speckled. The type is probably a female.

Emplesis bifoveata, n. sp.

♂. Dark brown, sometimes almost black, rostrum, antennae and tarsi paler. Densely clothed with rusty-brown scales, varying to sooty and stramineous.

Rostrum slightly longer than prothorax, thin, parallel-sided, slightly curved; with fine ridges and rows of squamiferous punctures to apical fifth (where the antennae are inserted), beyond which the punctures are dense and naked. Prothorax strongly transverse, sides dilated from base to near apex, and then suddenly narrowed. Elytra not quite parallel-sided to beyond the middle, base trisinuate; each with a small tubercle half-way down the apical slope. Abdomen with a median depression, dilated on two first segments and on fifth, the latter almost as long as second to fourth combined. Femora rather stout, tibiae longer and thinner than usual. Length, 3·5-4 mm.

♀. Differs in having the rostrum longer, thinner, more curved, glabrous throughout, and with much smaller and sparser punctures, antennae inserted two-fifths from apex, abdomen rather strongly and evenly convex, and fifth segment shorter.

New South Wales: Illawarra and Newport (H. J. Carter), Wollongong, Mittagong and Sydney (A. M. Lea). Queensland: Bunya Mountains (H. Hacker), Brisbane (A. P. Dodd). Type, I. 16325, in South Australian Museum, cotypes in Queensland Museum.

In appearance fairly close to *Storeus majusculus*, but claws simple, front tibiae of male not ciliated, and club pale. The under surface is usually obscurely reddish, but is sometimes black. The rostrum of the male is almost straight to the insertion of antennae, beyond which it is slightly bent. The clothing varies considerably, on some specimens it is almost entirely sooty-brown or rusty-red, the setae are often white, and with the blackish spots give the surface a speckled appearance (on some examples resembling *Storeus albosignatus)*, often the apical two-fifths of elytra are stramineous, except that the scales on the tubercles are black; frequently the scales on the sides of the prothorax are pale and like a reversed A. There is a rather conspicuous "peep-hole" on each side in front of the prosternum.

Three specimens, sexes, from the National Park of Queensland appear to represent a variety; they differ from the others in being somewhat narrower with most parts black or blackish, but speckled in places, especially about the summit of the apical slope.

Emplesis tarsalis, n. sp.

♂. Dark reddish-brown, tip of rostrum, antennae and parts of legs somewhat paler. Densely clothed with pale brown and sooty-brown, tessellated scales, becoming uniformly pale on under surface of body and of legs; basal joint of hind tarsi with a conspicuous fascicle at its inner apex.

Rostrum about the length of prothorax, curved only at apex; with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted); in front with numerous small punctures. Prothorax moderately transverse, sides evenly rounded, suddenly becoming narrower in front. Elytra elongate, base feebly trisinuate and distinctly, but not much, wider than prothorax. Abdomen with a feeble depression on two basal segments, third and fourth combined slightly longer than second or fifth. Femora stout, edentate. Length, 3·25-3·5 mm.

♀. Differs in being somewhat more robust; rostrum decidedly longer, thinner, strongly curved, paler, with ridges and squamiferous punctures only near base; antennae inserted in middle of sides of rostrum, abdomen more convex, and hind tarsi non-fasciculate.

Victoria: Mooroopna in April, Melbourne in August (F. E. Wilson). Type, I. 16420.

At first glance quite an ordinary-looking species, but very distinct by the fascicle on the hind tarsi of the male, this being quite as long as the claw joint. The tessellation of the elytra is of the usual kind, but on several specimens the paler markings form several wide V's; on the pronotum there are three dark vittae, of which only the median one is continuous, but in addition there are sometimes one or two feeble spots on each side; the head is not fasciculate between the eyes, but the clothing is denser there than elsewhere.

Emplesis ferruginea, n. sp.

♂. Dark brown, some parts almost or quite black, apex of rostrum and antennae reddish. Densely clothed with rusty-brown, feebly tessellated scales, and with numerous small dark spots; under surface of body and of legs with almost uniformly pale scales.

Rostrum slightly longer than prothorax, gently curved; with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with numerous small punctures. Prothorax moderately transverse, sides evenly rounded to near apex, which is suddenly narrowed. Elytra elongate-cordate, base gently trisinuate; with regular rows of large, partially concealed punctures. Abdomen with a shallow depression on first and second segments, third and fourth combined slightly longer than second, and distinctly shorter than fifth. Femora stout, edentate. Length, 4-4·5 mm.

♀. Differs in having the rostrum decidedly longer, thinner, more curved, paler, and clothed only close to base, abdomen evenly convex and legs slightly thinner.

New South Wales: Dubbo (H. J. Carter), Bogan River (J. Armstrong). Type, I. 16419.

In general appearance fairly close to *E. suturalis*, but larger, clothing less variegated, and different between the eyes; the head could scarcely be regarded as fasciculate, but there is a fringe of short scales at the side of each eye. It is almost as large as *E. sordida*, but the rostrum (both sexes) is shorter and the clothing is of a brighter colour. Slightly larger than *E. aenigmatica*, rostrum of male less curved, and clothing somewhat different. The tessellation of the elytra is faint, but is rendered fairly distinct by small blackish spots, of which there are from ten to twelve on each elytron, on the pronotum there are three short and usually inconspicuous vittae. The setae on the upper surface are numerous, but being pressed flat amongst the scales they are not very distinct. From some directions the scutellum appears as a small white spot. There are two pale setae at the apex of the abdomen of the male.

A female from Tooloom (New South Wales) in the Queensland Museum, taken by Mr. H. Hacker in January, is rather more brightly coloured than the Dubbo specimens, and the clothing on its under surface is less pale.

Emplesis masculina, n. sp.

♂. Reddish-brown, club and glabrous portion of rostrum not much paler. Densely clothed with greyish-white and stramineous scales, tessellated on elytra, but posteriorly with darker spots or blotches; pronotum with three dark vittae, of which the median one is longer than the others but less distinct; under surface and legs with uniformly whitish scales.

Rostrum slightly longer than prothorax, moderately curved, derm concealed behind antennae (at apical third); in front with crowded, sharply defined punctures. Prothorax moderately transverse, sides rather strongly rounded, especially near apex. Elytra elongate-subcordate, base slightly trisinuate; with rows of large punctures, appearing much smaller through clothing. Abdomen

with a shallow depression on two basal segments, third and fourth combined the length of second and slightly shorter than fifth. Legs stout. Length, 3-3·5 mm.

♀. Differs in being slightly more robust, in having the rostrum slightly longer, thinner, and more curved, antennae inserted two-fifths from apex of rostrum, and abdomen evenly convex, except for a slight depression on apical segment.

North-western Australia: Fortescue River and Roebourne (W. D. Dodd). Type, I. 16421.

There are 56 specimens before me from the Fortescue River, and 15 from Roebourne, and by the examination of the rostrum alone, they would appear to belong to males of two species, owing to the female having the rostrum clothed almost to the insertion of antennae, but the sexes may be distinguished with certainty by the abdomen. The female resembles the males of several other species of the genus, and strongly resembles the male of *E. femoralis,* and I can only distinguish them with certainty by the abdomen; the female of *femoralis,* however, differs from the female of the present species in having a considerably longer and more strongly curved rostrum, with the antennae median, and the clothing of the rostrum less pronounced, although denser than is usual on females of the genus. The tessellation of the elytra (which is easily disarranged) is more conspicuous about the middle than elsewhere, but it varies considerably, the stramineous parts sometimes change to a rather dark brown, and on such specimens the dark apical spots are almost black. On many the majority of the scales on the apical slope are dark brown, variegated with light brown or slaty-grey. Although the derm of the rostrum is quite concealed behind the antennae, it is evident by the arrangement of the scales that hidden ridges and rows of punctures are present, these being indicated even on the females.

Emplesis parvidens, n. sp.

♂. Black, parts of elytra and of abdomen, rostrum, antennae and legs reddish. Densely clothed with black, whitish and stramineous scales.

Rostrum comparatively stout, slightly shorter than prothorax, parallel-sided, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with dense naked punctures. Prothorax moderately transverse, sides gently rounded to near apex, which is about half the width of base. Elytra elongate-subcordate, sides almost parallel to beyond the middle, base almost truncate. Two basal segments of abdomen depressed in middle, fifth slightly longer than second. Femora feebly dentate; front and middle tibiae each with a small projection on middle of lower surface. Length, 2·5 mm.

South Australia: Lucindale (B. A. Feuerheerdt). Type (unique), I. 16296.

A beautiful species approaching *E. amoena,* but narrower, less white on elytra, and abdomen partly reddish posteriorly. The black elytra patches are much as on *E. nigrofasciata* and *Storeus contortus*, but the white ones are different, and the prothorax is very differently clothed. The middle and hind femora are feebly dentate, the front ones just perceptibly so. On the elytra the clothing is mostly stramineous, with a large black postmedian spot on each side, small dark spots alternated with whitish ones on the suture, and a few similarly coloured spots elsewhere. On the pronotum the clothing is black, with a pale V and some small spots on the sides. On the head and rostrum the clothing is black, becoming conspicuously pale between the eyes. On the under parts it is mostly whitish.

On this and the seven following species the femora, or at least some of them, are dentate; the claws of all have been carefully examined and usually at least one has been detached for examination under a high power.

Emplesis parilis, n. sp.

♂. Black, parts of elytra, tip of abdomen, antennae, tibiae and tarsi more or less obscurely reddish. Densely clothed with scales varying from white to black on upper surface, white on under parts.

Rostrum almost the length of prothorax, parallel-sided, slightly curved; with fine ridges, alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with dense, sharply defined punctures. Prothorax slightly longer than basal width, sides dilated to near apex and then suddenly narrowed. Elytra elongate-subcordate, base slightly bilobed. Abdomen with a wide depression common to two basal segments, fifth slightly longer than second. Femora acutely dentate; front and middle tibiae each with an obtuse projection in middle of under surface. Length, 3·5 mm.

♀. Differs in having the rostrum slightly longer, glabrous throughout, ridges and seriate punctures well defined to insertion of antennae (at apical two-fifths), punctures in front smaller but the median ridge distinct to apex, abdomen more convex, the sub-basal depression much smaller and fifth segment somewhat smaller.

Tasmania: Tunny (Rev. T. Blackburn), Hobart (A. M. Lea). Victoria: Killara (C. Oke). Type, I. 16295.

Allied to but larger than the preceding species, rostrum and legs darker, elytral and prothoracic markings somewhat different, and femora more strongly dentate. In general appearance it is fairly close to *Storeus amoenus* and *contortus*, but the claws are not appendiculate. The projection on the tibiae is quite as distinct on the male as on the female, not confined to the former as on *E. tibialis* and *subtibialis*. The majority of the scales on the elytra of the male are whitish or stramineous (some with a slight golden lustre in certain lights), there are two large much interrupted black spots (or an irregular fascia) just before the apical slope, on the slope itself the scales are mostly stramineous, on the suture the clothing is alternately black and white, and some brownish spots are scattered elsewhere. On the pronotum the scales are black, with a white patch on each side at the base. There are a few ochreous sloping scales between the eyes, but not a crest, very different from the white patch of *S. amoenus*. On the female the clothing is brighter, the black and white elytral spots are more sharply limited, and the prothoracic clothing is more variegated and uneven, and on each side forms the remnant of an inverted A.

Emplesis longicollis, n. sp.

Black, rostrum, tarsi and parts of elytra obscurely reddish, antennae somewhat paler, but club slightly infuscated. Densely clothed with black, dingy-white and somewhat stramineous scales.

Rostrum the length of prothorax, thin, moderately curved; with fine ridges alternated with rows of punctures (squamiferous only close to base) to between antennae (these inserted at apical two-fifths), in front punctures small but still seriate. Prothorax slightly longer than wide, sides feebly dilated to near apex, and then strongly narrowed to apex itself. Elytra elongate-subcordate, base faintly trisinuate (almost evenly arcuate). Abdomen evenly convex, fifth segment no longer than second. Femora acutely dentate. Length, 3 mm.

Western Australia: Yilgarn (Blackburn's Collection from E. Meyrick). Type (unique), I. 16297.

The elytral markings approach those of *E. amoena*, but the prothorax is very different. There is a fairly large postmedian black patch towards the side of each elytron, on the suture and some of the odd interstices there are some small black spots, elsewhere the white and stramineous clothing is obscurely mixed; on the pronotum the markings are not sharply defined (possibly through partial

abrasion); the head is densely clothed with white scales between the eyes, but its base is concealed. The type appears to be a female, although the ridges on the rostrum are rather sharply defined.

Emplesis composita, n. sp.

Reddish-brown, metasternum and first and part of second segments of abdomen black. Densely clothed with whitish scales, on the upper surface slightly mottled with brownish and stramineous ones.

Rostrum glabrous, about the length of prothorax, moderately curved, parallel-sided, with dense punctures becoming seriate near base. Antennae inserted one-third from apex of rostrum. Prothorax slightly transverse, sides rather strongly rounded. Elytra narrow, sides nowhere quite parallel, base gently and evenly arcuate. Fifth segment not as long as second and third combined. Femora slightly dentate, the hind ones more strongly and acutely than the others. Length, 3 mm.

New South Wales: Forest Reefs (A. M. Lea). Unique.

The darker spots of clothing on the upper surface are small and ill-defined, and cause it to appear slightly mottled, rather than tessellated; somewhat as on *Storeus scutellaris*, but the club is pale and the claws are not appendiculate. The type is probably a male; the tip of the first segment of its abdomen is slightly notched, as on the females of several species of the genus.

Emplesis grata, n. sp.

♂. Black, rostrum, antennae, legs and parts of elytra obscurely reddish. Densely clothed with white scales, in parts somewhat stramineous, and with conspicuous black markings.

Rostrum about the length of prothorax, parallel-sided, moderately curved, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted), in front with dense punctures. Prothorax as long as wide, sides moderately rounded. Elytra elongate-cordate, base bilobed. Abdomen scarcely flattened along middle, fifth segment scarcely longer than second. Femora acutely dentate. Length, 2 mm.

♀. Differs in having the rostrum slightly longer and more curved, clothed only near base, antennae inserted two-fifths from apex and abdomen more convex.

South Australia: Lucindale (A. M. Lea). Type, I. 16298.

A minute, beautifully marked species, smaller than *E. amoena*, and the others with a large black patch on each elytron; the patch is irregularly triangular, postmedian and sub-lateral; there are also some small blackish markings on other parts of the elytra and on the pronotum.

Emplesis lata, n. sp.

♂. Black, tip of rostrum, antennae and tarsi obscurely reddish. Densely clothed with scales varying from almost white, through muddy-brown to black; almost uniformly white on under parts.

Rostrum slightly longer than prothorax, moderately curved, with fine ridges alternated with rows of squamiferous punctures to apical third (where antennae are inserted), in front with crowded, sharply defined punctures, the median ridge continuous to apex. Prothorax strongly transverse, sides strongly rounded, apex less than half the width of base. Elytra wide, sides nowhere parallel, base trisinuate, alternate interstices slightly elevated. Abdomen with first and second segments feebly depressed along middle, fifth as long as second and third combined, with a fairly large shallow depression. Front femora edentate, middle pair slightly, the hind ones more strongly dentate. Length, 3·5 mm.

New South Wales: Bogan River (J. Armstrong). Type (unique), I. 16294.

A fairly large, unusually wide species, about the size of *Storeus variegatus,* but with very different markings. There are no large patches of any colour on the upper surface, most of the scales being muddy-brown or stramineous-brown, mottled with numerous darker spots; there are a few pale spots on the elytra. The setae are mostly black, and there is a small cluster of them on the front of the pronotum, causing its middle to appear almost pointed.

Emplesis stenoderes, n. sp.

♂. Blackish-brown, most of elytra, abdomen, rostrum, antennae and legs more or less obscurely reddish. Densely clothed with variegated scales, becoming uniformly pale on under surface and legs.

Rostrum about the length of prothorax, slightly curved, with fine ridges alternated with rows of squamiferous punctures to apical third (where the antennae are inserted); in front with numerous small sharply defined punctures. Prothorax slightly longer than wide, sides gently rounded, front moderately narrowed. Elytra rather narrow, but distinctly wider than prothorax, elongate-subcordate, base feebly trisinuate; with rows of large, sub-approximate, but partially concealed punctures. Abdomen with a rather large depression on two basal segments, second slightly shorter than fifth and slightly longer than second and third combined. Front femora edentate, middle ones feebly, hind ones moderately dentate. Length, 3 mm.

South Australia: Mount Remarkable in October (F. E. Wilson). Type (unique), I. 16417.

In some respects close to *E. captiosus,* but the prothorax is slightly longer than wide; on that species it is transverse. On the pronotum the scales are mostly sooty, irregularly interspersed with whitish ones, on the elytra the scales are mostly stramineous, with feeble dark spots, but there is a large dark one on the basal half bounded posteriorly by a sub-fasciate patch of snowy scales, and at the base, and on the third interstices near base with whitish ones, the base of the rostrum and the head between the eyes are densely clothed with stramineous ones.

Emplesis leucomela, n. sp.

♂. Black, rostrum and abdomen obscurely paler, antennae and tarsi reddish. Densely clothed with sooty scales, becoming pale (but not white) on under surface and base of femora, a conspicuous white triangular spot on each side of base of prothorax, and a short white fascia just beyond the middle of elytra, a few white or whitish scales behind it and on the shoulders.

Rostrum slightly shorter than prothorax, almost straight; with fine ridges alternated with rows of squamiferous punctures to beyond antennae (these inserted at apical two-fifths), with rather dense punctures in front. Prothorax almost as long as its greatest width, sides moderately rounded, becoming suddenly narrower in front. Elytra elongate-cordate, base feebly trisinuate, distinctly wider than prothorax; with regular rows of large sub-approximate, partially concealed punctures. Abdomen without sub-basal depression, third and fourth segments combined slightly longer than second and fifth. Femora rather stout, front ones edentate, hind ones feebly dentate. Length, 3·5 mm.

Victoria: Woori Yallock (F. E. Wilson). Type (unique). I. 16418.

Distinct from the other species with dentate femora, by its sooty clothing, with white patches. The rostrum is less curved than on *E. parilis.* The prothorax is longer than usual, but shorter than on the preceding species. The tooth on each hind femur is small and distinct from but few directions, the middle pair are almost edentate. The upper surface has dense sooty setae, but they are distinct only from the sides. From some directions the scutellum appears as a small white spot.

ON A NEW GENUS OF CALCAREOUS ALGAE, FROM THE LOWER CAMBRIAN (?), WEST OF WOOLTANA, SOUTH AUSTRALIA.

By Fredk. Chapman, A.L.S., F.G.S.,

Hon. Fellow Royal Society South Australia.

[Read June 9, 1927.]

Plate VI.

Introduction.

Although those thallophytes which secrete a considerable amount of calcareous material in their tissues are recognised as important rock-forming organisms, they have not been so intimately studied as they deserve. There is, indeed, a great field for research in this respect amongst the oldest Australian rocks, and we are further reminded of this by Sir Douglas Mawson's recent discovery of a unique type of calcareous alga in the Flinders Ranges. There is little doubt that we have in this ancient thallophyte a form which, instead of growing with a ball-like or sub-spheroidal contour, was actually frondose, the separate segments of which can be plainly seen in sections prepared from the rock specimens.

It was on account of its peculiar segmented appearance that Sir Douglas Mawson compared this limestone-forming alga with *Halimeda*, one of the jointed and frondose green algae so abundant in coral lagoons. Referring to the discovery of this fossil in his paper on "Evidence and Indications of Algal Contributions in the Cambrian and Pre-Cambrian Limestones of South Australia" (Mawson, 1925, p. 188), Sir Douglas Mawson says, under the heading "Limestones West of Wooltana":—

"In another area in the Flinders Ranges, some 35 miles north of Italowie and about 9 miles west of Wooltana Head Station, is a region of calcareous strata superior to the Proterozoic tillite horizon. Thereabouts curious markings were noted in the rocks in several places suggestive of organic origin. In the case of some boulders in the creek at McLeach's Well, the markings in the rock very closely resemble the packed fan-shaped segments of *Halimeda*."

One of these limestone specimens and some microscope slides have been very kindly sent to me by Sir Douglas Mawson, and upon these I have based the following notes:—

Macroscopic appearance of the Rock.

The cut surface of the limestone shows it to consist of a mass of thick-jointed segments of the alga. From the way the separate segments follow one another in the matrix, and sometimes slightly diverge or radiate, there is no doubt of its character as a jointed organism. There is very little cement or matrix to the rock, and this is well seen in a weathered surface, where the dark-coloured infillings or mineralised interspaces consist of less pure calcareous material than the algal, and so stand out as a rudely polygonal network in relief around the whitened algal particles.

Description of the Organism.

Class CHLOROPHYCEAE.

Genus **Mawsonella**, n. g.

(For generic characters see below, in description of genotype.)

Mawsonella wooltanensis, n. g. et sp.

Pl. vi.

Description. Thallus calcareous, consisting of numerous ovoid joints, attached by short, intervening, thread-like connections which, when the joints are detached, resemble small prickles with blunt heads. In thin section the internal structure of these joints is seen in a few instances in a very well-preserved condition.

There is no division into an external and an internal layer of cells, as in *Sphaerocodium*, but an almost invariable coating of small dolomite or calcite crystals around the joints may indicate a cuticular differentiation. The cellular structure of the thalloid substance is very minute, and although there is a rudely reticulate arrangement throughout the mass, there are portions where the cells branch and dichotomise after the manner of *Epiphyton* (Chapman, 1916, p. 82). In one or two places there may be seen asteroidal groupings of the cells; in most others it is a reticulate arrangement.

The elements which connect the joints of the thallus appear to be of closer or more solid texture than the mass of the thallus, and accordingly appear darker in section. In the basal portion of the larger joints there is often a linear system of denser cells starting from a vesiculate series that later breaks up into cervicorn prolongations and thence into distal radiate lines. These radiate lines occasionally show curved transverse connections, which give to them a vesiculate character.

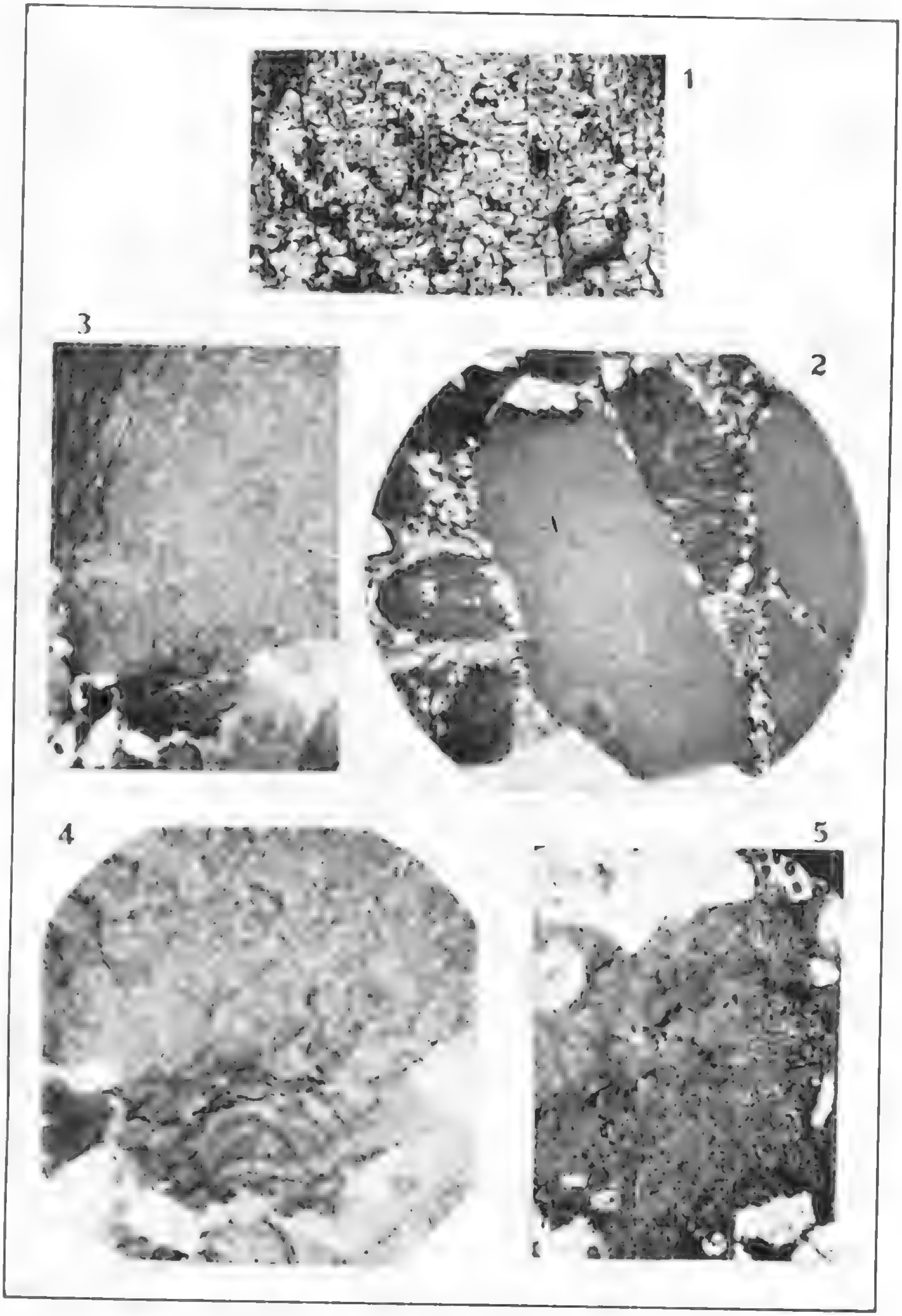
Dimensions.—Largest joints measure 5×4 mm. Average size of joints, circ. $3 \times 1\frac{1}{2}$ mm.

Observations.—The substance of the thallus is, in many cases, invaded by crystallisation. This is in the form of numerous tiny spicular and lath-shaped forms and probably calcitic. In other cases large crystals of calcite, generally distinctly twinned and sometimes zoned, are seen occupying a large portion of the original thallus, often to the extent of cutting the segment in halves.

The matrix of the rock was probably once a calcareous mud, intermingled with quartz grains. The mud has since crystallised, almost to the obliteration of any other organisms that may have been present. There is, however, an interesting example of a foraminifer occurring in one of the slides, which seems to have been preserved by being included in the basal part of a joint of the alga; this is perhaps referable to the genus *Truncatulina*.

Relationships.—So far as I have seen, the nearest forms to the present algal type is that of the fossils named by Dr. Chas. D. Walcott,[1] ?*Sphaerocodium*, and which he found in the Middle Cambrian of Burgess Pass, British Columbia. He described two species (Walcott, 1919, p. 243, pl. lix., figs. 1, 1*a-c*, and fig. 2) as ?*Sphaerocodium praecursor* and ?*S. cambria*. Neither of these forms appears to be really referable to the genus *Sphaerocodium*, since the tubular cells of the

(1) Since these notes were written I have learned with the deepest regret of the death of Dr. C. D. Walcott, the Secretary of the Smithsonian Institution at Washington. Dr. Walcott has rendered me great service through his ever-ready and kindly advice on matters pertaining to the Cambrian faunas, on which he was undoubtedly the highest authority, and I take this opportunity of expressing my warmest feelings for his genial friendship and encouragement in our common work .



F. C. Photo.

New Calcareous Alga from the Cambrian of S.A.

Gillingham & Co. Limited, Printers, Adelaide

thallus, although apparently interlacing, are very minute and crowded, and there is no external layer of saccate cells, as in the recent genus *Codium*.

One of Dr. Walcott's species, however, namely, ? *S. praecursor*, bears more than a fancied resemblance to the present algal fossil from South Australia. In point of size the thallus of ? *S. praecursor* as figured by Walcott is about one-third the dimensions of the present species, whilst the tubes are of about the same diameter.

Some years ago I described another species of *Sphaerocodium* from the Middle Devonian limestone in North-east Gippsland, Victoria, as *S. gippslandicum* (Chapman, 1920, p. 182, pl. xvi., fig. 1); this I am now inclined to regard as possibly belonging to a new genus, on account of the internal filamentous cells being dendroid rather than interlacing, as in the living *Sphaerocodium*. This Devonian form does not, however, show any marked resemblance to the present genus *Mawsonella*, and, moreover, the tubes of the interior of the thallus are about ten times the diameter of that genus.

Bibliographic References.

Chapman, F.

1916—Report on a Probable Calcareous Alga from the Cambrian Limestone Breccia found in Antarctica at 85° S., Geology (vol. ii.), Brit. Ant. Exped., 1907-8, pp. 81-83, pl. i.

1920—Palaeozoic Fossils of Eastern Victoria, Part IV., Records Geol. Surv. Vict., vol. iv., pt. 2, pp. 175-194, pls. xvi.-xxxii.

Mawson, D.

1925—Evidence and Indications of Algal Contributions in the Cambrian and Pre-Cambrian Limestones of South Australia, Trans. Roy. Soc. S. Austr., vol. xlix., pp. 186-190, pls. xiii.-xv.

Walcott, C. D.

1919—Middle Cambrian Algae, Cambrian Geology and Palaeontology, Ser. IV., Smithsonian Miscellaneous Collections, vol. lxvii., No. 5, pp. 217-260, pls. xliii.-lix.

DESCRIPTION OF PLATE VI.

Fig. 1. Weathered surface of a fragment of limestone containing *Mawsonella*. ×1⅓.

Fig. 2. Section of limestone, magnified, showing general appearance of the joints and the secondary crystallisation around them. ×26.

Fig. 3. A basally attached joint, showing coarse cystoid strands. ×26.

Fig. 4. The same, more highly magnified, showing the fine strumose cell-structure of the main body of the thalloid segment. ×52.

Fig. 5. Another joint, showing fine cell-structure and an included foraminiferal test, (?) *Truncatulina*. ×52.

THE MANNUM GRANITE.

By B. F. Goode, B.Sc.
(Communicated by Sir Douglas Mawson.)

[Read July 14, 1927.]

This granite outcrops over a comparatively small area on the slope of the eastern bank of the River Murray on Section 156, Hundred of Younghusband. The location is about two and a quarter miles up stream from Mannum township.

Erosion of the overlying Tertiary beds has laid bare a narrow strip of the granite, about three-eighths of a mile in length, with a maximum width of nearly one hundred yards. There is also a smaller patch a quarter of a mile to the northwards. The extent of the occurrence, small though it is, is not at first sight apparent, as the rock itself is exposed only on the slope of the river bank, being elsewhere covered by soil and detritus. Overlying and immediately surrounding this granite are the highly fossiliferous yellow limestones of the Murray plains. It is obviously related to the Murray Bridge and Swanport granite outcrops, and undoubtedly dates from Palaeozoic or pre-Palaeozoic times.

Numerous bands of fine-grained aplite traverse the granite in its north-eastern portion. These are parallel and strike in a direction 140 degrees east of north. The maximum thickness observed was 30 inches.

At the opposite end of the outcrop, and extending parallel to the aplite, is a dark, basic dyke about 2 feet in breadth. Also in a quarry face are exposed basic segregations and a coarse-grained aplite. The granite is quarried and used in the building of locks now under construction along the River Murray. These quarrying operations have exposed many drusy vughs containing fine crystals of orthoclase, biotite, pyrites, and smoky quartz.

Macroscopic Features.

The granite is a medium to coarse, fairly even-grained rock containing numerous small miarolitic cavities. The most obvious mineral is orthoclase present in coarse crystals which show fine cleavage faces and lend to the rock a pinkish colour. Plagioclase is less obvious but present in smaller crystals. Quartz is plentiful with a decidedly smoky appearance; mica is comparatively scarce, and is scattered through the rock in small dark flakes; small grains of pyrites are numerous, and iron ore is discernible with a lens.

Round the edge of the intrusion, the granite has more of a grey colour; porphyritic crystals of pink orthoclase are numerous, but are all partially altered and surrounded by an outer white zone. In a few cases complete kaolinization is indicated. The groundmass is almost felsitic, relieved by coarser grains of quartz and biotite. Biotite is more plentiful than in the normal rock.

Microscopic Features.

It is a holocrystalline, medium-grained, allotriomorphic granular rock, of medium to coarse grain size. The minerals contained are quartz, orthoclase, microcline, plagioclase, biotite, sphene, magnetite, pyrites, chlorite, apatite, and zircon.

Quartz is present in numerous irregular grains, mostly clear, but many exhibit relics of former cracks and contain fine dust-like inclusions. Rarely, fragments are met with graphically interwoven felspar. Abundant orthoclase appears in perfectly fresh and clear anhedral crystals. Some few of the larger pieces are turbid through alteration to aggregates of fine grains of sericite, kaolin, and quartz. Much of the orthoclase is perthitically intergrown with albitic plagioclase in large individuals. In these cases the orthoclase is turbid. Microcline occurs in rare crystals exhibiting the characteristic cross-hatching under crossed nicols.

Plagioclase occurs mainly perthitically intergrown with orthoclase, but is present also in small subhedral pieces. These are quite clear and show no sign of alteration; under crossed nicols they show fine lamellae due to albite twinning and, in rare examples, pericline twinning. The fineness of the stripes suggests a highly sodic variety, and in the perthite it has a maximum extinction angle of 12 degrees, determining it as albite.

The plagioclase crystals, apart from that of the perthite, have a maximum extinction of 10 degrees on sections cut perpendicular to the O1O face, showing that it is albite-oligoclase.

Biotite mica is present in small quantity. It occurs in small flakes containing a few inclusions and is pleochroic from brown to pale brown. It is slightly altered to chlorite.

Sphene occurs in fairly numerous highly refracting wedge-shaped crystals, pale brown in colour. Apatite is present as extremely fine lath-like crystals. Magnetite is not plentiful, but a few fairly large irregular grains and cubes are to be seen. Pyrites is comparatively plentiful in grains and cubes. Zircon is rare. Chlorite appears as occasional green flakes, due to alteration of biotite.

Chemical Composition.

A chemical analysis of the granite gave the following results:—

Constituents.	Percentage.	Constituents.	Percentage.
SiO_2	70·77	H_2O-	·36
Al_2O_3	13·69	TiO_2	·72
Fe_2O_3	1·97	P_2O_5	·11
FeO	·97	FeS_2	·17
MgO	·34	MnO	·28
CaO	·94	ZrO_2	tr.
Na_2O	3·70		
K_2O	5·68	Total	100·15
H_2O+	·45		

Specific gravity, 2·66.

Most of these figures are quite normal for a granite, the magnesia is low but is explained by the paucity of mica and the absence of other ferro-magnesian minerals. Of the alkalies, potash seems to predominate to a greater extent than is usual in South Australian granites. The molecular proportions of potash and soda are equal, and in microscopic sections orthoclase and plagioclase are roughly equal in amount. The apparent predominance of orthoclase is due to the abundance of perthite.

The Norm.

The calculation of the norm yields the following minerals and their percentages:—

Quartz	25·32	Ilmenite	1·37
Orthoclase	33·36	Pyrites	·17
Albite	31·44	Apatite	·34
Anorthite	3·89	Water	·81
Enstatite	·90		
Magnetite	2·09	Total	100·17
Haematite	·48		

Position in C.I.P.W. Classification:—

Class I.	Persalane
Order 4	Britannare
Rang 1	Liparase
Sub-Rang 3	Liparose

The Mode.

Microscopic measurements carried out by the Rosiwal method gave the following actual percentage mineral composition:—

Quartz	25·99	Sphene	1·86
Orthoclase	34·09	Apatite	·62
Plagioclase	30·75		
Biotite	3·13	Total	99·77
Iron Ores	3·33		

From these figures it will be seen that the values of quartz and orthoclase correspond almost exactly with the norm. Plagioclase is slightly lower but is approximately equal. Ferromagnesian minerals are much higher, but this inaccuracy is due, perhaps, to the large and scattered nature of the flakes of biotite. Iron ores are of the same order. Sphene, on reduction to ilmenite, corresponds in the ratio of 1·44 in the mode, 1·37 in the norm. Apatite has almost twice the value in the norm, but the fineness of the crystals renders it difficult to measure them.

NEW TREMATODES FROM AN AUSTRALIAN SILUROID.

By Professor T. Harvey Johnston, University of Adelaide.

[Read July 14, 1927.]

The Australian freshwater jewfish, or catfish, *Tandanus* (or *Copidoglanis*) *tandanus*, has a wide distribution in the eastern half of the continent, and several parasites have been recorded as occurring in it, *viz.*, a Gyrodactyloid trematode, *Anchylodiscus tandani*, Johnston and Tiegs, from the gills; a Caryophyllaeid cestode, *Lytocestus (Balanotaenia) bancrofti*, Johnston, from the intestine; a trematode, *Isoparorchis* sp., Johnston, from its gas bladder; and a Trypanosome, *T. bancrofti*, Johnston and Cleland, from its blood—all from Queensland localities. Most of the material referred to above, as well as most of that described in this paper, was collected by Dr. T. L. Bancroft, or his daughter, Dr. M. J. Mackerras, to both of whom thanks are due. The paper contains an account of two species of trematodes which occur in the gas bladder of this fish.

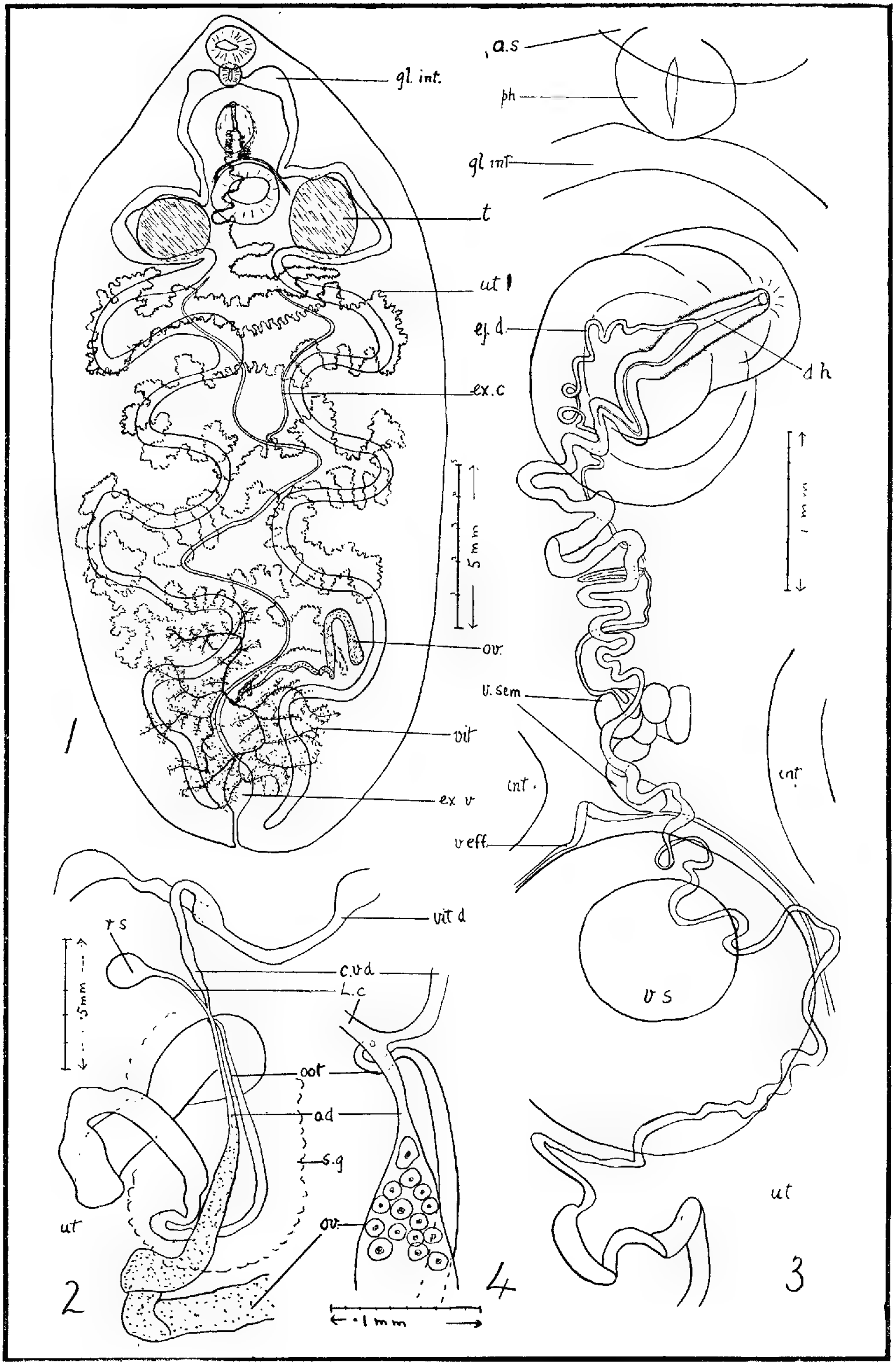
Isoparorchis tandani, n. sp.

A. Figs. 1-4.

This is a large trematode, specimens examined measuring 30 mm. by 15 mm. (somewhat compressed), 25 mm. by 12 mm., and 21 mm. by 11 mm., while the smallest measured 17 mm. by 8 mm. and possessed abundant ripe eggs. The anterior end is thickest and somewhat pointed, the posterior being rounded. There is little variation in the width of the parasite from the region of the testes to that of the ovary, though compressed specimens may show a considerable widening in the middle third.

The body (when preserved in formalin) is more or less transparent, the darkly-coloured uterus and intestine showing through very plainly, while the rounded whitish testes are also very obvious, especially from the dorsal aspect. The cuticle is smooth. In the case of the larger worms the diameters of the anterior and ventral suckers were 1·7 mm. and 2·1 mm. respectively (ratio 1 : 1·2); 1·6 mm. and 2·1 mm. (ratio 1 : 1·3); 1·0 mm. and 1·2 mm. (ratio 1 : 1·2). The prominent ventral sucker is situated at about one-fifth the body length from the anterior end. The genital pore lies in the midventral line and at a distance from the oral sucker about one-third the interval between the latter and the acetabulum. There is a muscular pharynx, about 0·6 mm. in diameter, continuous with the oral sucker which it partly overlies, and is succeeded by an extremely short oesophagus which overlies it dorsally. The latter soon branches into two long simple intestinal caeca which are thrown into a fairly regular series of curves—a slight one between the two suckers in the vicinity of the genital pore, then the limbs of the intestine approach the ventral acetabulum sucker very closely; then follows a wide loop partly investing the corresponding testis; this being followed by four others, the last being slight, while the one anteriorly to it lies in the vicinity of the ovary. The ends of the caeca approach very closely to the excretory vesicle at the posterior extremity of the worm. The extreme anterior portion of each caecum is specialised as a "glandular stomach" and differs in appearance from the rest of the tube.

The main excretory canal is long and sinuous, extending from the rather large excretory vesicle to a point near the middle of the length of the parasite, where it bifurcates, each limb passing forwards in a series of curves near the intestinal loops.


a.s
ph
gl. int.
gl int
t
ut
ej. d.
d h
ex.c
ov.
v. sem
vit
int.
int
ex v
v eff.
vit d
r s
c.v.d
L.c
oot
ad
s.g
ut
ov.
v s
ut
1
2
3
4
·1 mm

A. Figs. 1-4.

The testes are rounded, entire and approximately equal, measuring 1·5 mm. to 2 mm. in diameter. They lie on either side of the acetabulum, their anterior border being more or less on a level with the middle of the sucker. They are closely invested by the intestinal loops. The vasa efferentia arise from the inner anterior margins and pass just in front of the ventral sucker as very narrow tubes which soon join to form a swollen vesicula seminalis. The latter is thrown into a number of close coils and then becomes a very delicate, rather long, ejaculatory duct which travels in a sinuous or slightly coiled course above the uterine coils, and then diverges somewhat from the latter to enter the muscular genital sac. It terminates beside the uterine pore, at the bottom of the ductus hermaphroditicus.

The ovary is a long tubular organ, more or less bent in various directions, measuring over 9 mm. in the longest specimen examined, and over 6 mm. in the next longest. The width is about 0·25 mm. It may lie on either side, since in four mature specimens it was found on the right, and in two on the left. Its general position is more or less transverse, though the outer end may be bent posteriorly. Its inner portion becomes markedly narrowed into a short oviduct whose lumen is only 0·01 mm., sufficiently wide to admit the passage of an ovarian egg, the latter measuring about 0·015 mm. in diameter, but capable of elongating as it travels down the duct. The latter soon receives the vitelline duct and becomes sharply bent back on itself as the ootyp, which is very narrow (about 0·012 mm. in diameter). This uterine duct passes beside and immediately above the oviduct for a short distance, and then widens into the uterus in the vicinity of the lower *(i.e.,* inner) part of the ovary, becoming thrown into a series of coils and loops, some of which overlie the uterine duct. The uterus is a very long, rather narrow, duct thrown into a series of wide curves passing across the worm between and slightly beyond the intestinal caeca and dorsally to them, each curve being thrown into a series of smaller undulations. In the vicinity of the acetabulum the tube becomes narrow again, passing above dorso-laterally to the sucker, thence forwards below the vesicula seminalis and ejaculatory duct to enter the muscular genital sac and terminate at the ductus hermaphroditicus.

The genital sac, which, apparently, is homologous with the cirrus sac of other trematodes, is a very muscular organ, 0·8 mm. to 1 mm. wide, surrounding the terminal part of both male and female ducts, particularly the latter. The ductus is eversible, as some preparations show the organ partly extruded as a wide structure projecting through the genital pore. The enclosed portion of the uterus and ductus is surrounded by a layer of deeply-staining (? glandular) cells.

The two vitelline glands are greatly branched and lie in the posterior quarter of the parasite, the one on the ovarian side being rather more posteriorly situated than its fellow, and, besides, it invades the other side somewhat. The glands are markedly dendritic, each consisting of about five main branches which subdivide two or three times and terminate in a great number of short processes, so that the two glands appear somewhat like an irregular broken network occupying the space behind the uterus and ovary and between the intestinal crura, though they overlap parts of the latter and may extend laterally beyond them. Except in the vicinity of the shell gland no part of the ovary or uterus is covered by the vitellarium. The two glands are connected by a swollen duct from the narrower mid-region of which a common vitelline duct is given off ventrally to curve forwards and after a short course join the oviduct as it enters the shell gland. At the junction there is given off dorsally a short Laurer's canal terminating blindly in a rounded

---

DESCRIPTION OF TEXT FIG. A.

References to the lettering will be found at the end of the article.

Isoparorchis tandani.

Fig. 1: Entire worm, ventral view. 2: Female organs. 3: Male ducts, etc. 4: Junction of oviduct and other ducts.

or pyriform receptaculum seminis, ·12 mm. in diameter, which lies ventrally to parts of the vitellarium. The shell gland is not a very obvious structure in stained preparations, though it occupies a considerable area, about 1 mm. by ·65 mm. Eggs are thin-shelled and measure 45 μ to 52 μ by 25 μ to 27 μ. At the end opposite the operculum, the shell shows a small rounded apical thickening. The miracidium while enclosed in the shell is about 40 μ long.

The species obviously belongs to *Isoparorchis,* Southwell (1913), whose type species, *I. trisimilitubis,* occurs in the gas bladder of an Indian Siluroid, *Wallago attu.* The form herein described was recorded by me (1914) under its generic name only, from *Tandanus tandanus,* obtained from the Condamine River (Murray-Darling system) in Southern Queensland, and later (1916) from the same host species in the Dee (Dawson-Fitzroy system) and Burnett Rivers which belong to the Pacific slopes.

In 1920 Kobayashi (p. 396) described a new genus and species, *Leptolecithum eurytremum* as infesting the gas bladder of certain Japanese Siluroids. In June, 1926, Bhalerao announced the synonymy of the two genera, tabulated the chief characters of the two parasites, and concluded that they belonged to Southwell's species. He also mentioned that the ovary was situated on the right in the Indian parasite, and that perhaps Kobayashi may have been in error in describing the organ as lying on the left in the Japanese material examined. I have shown above that both men may have been correct in their statements, as the organs may be placed either on the left or on the right side in the Australian species. A comparison of the figures given by Southwell and Kobayashi, together with the distribution of the hosts in each case, leads one to disagree with Bhalerao's view as to the identity of the species. There are marked differences in regard to the general outline of the worms; the relative sizes of the two suckers and their distance from one another in relation to body length; the size of the testes; and the position at which the main excretory stem bifurcates. It is in all of these points that both *I. trisimilitubis,* Southwell, and *I. eurytremus* (Kobayashi) differ from *I. tandani.* All known members of the genus occur in the gas bladder ("gall bladder" in Bhalerao's table, p. 247, being obviously a misprint for gas bladder) of Siluroids.

Kobayashi placed his genus in the Hemiuridae and stated that it was related to the *Distomum clavatum* group. This latter assemblage has been assigned to *Hirudinella,* and was regarded by Odhner (1911) as belonging to an undesignated subfamily, but Nicoll (1914) listed it under Accacoeliinae. Manter pointed out many similarities to the Azygiidae except in regard to the form of the vitellaria (which are tubular in *Hirudinella)* and the position of the ovary and testes, the latter being immediately postovarian. The strongly muscular body of *Hirudinella* as well as the position of the various sex organs mark the genus off sharply from *Isoparorchis.* In *Accacoelium* the testes are postacetubular, one behind the other, the ovary a little distance posttesticular and the vitellaria dendritic along each side of the body. Except for the position of the vitellaria, *Isoparorchis* shows certain similarity to *Leuceruthrus* (which is usually placed in the Azygiidae in spite of the relative positions of the testes and ovary, though Goldberger, 1911, regarded it as probably representing a new family), and especially to *Halipegus.*

Isoparorchis does not seem to fall into any of the known subfamilies of Hemiuridae, though it appears nearer to the Accacoeliinae. It is suggested that a new subfamily Isoparorchinae be erected to receive the genus, a provisional diagnosis being:—Hemiuridae; body weakly muscular; posterior region not telescopic; testes preovarian, near acetabulum; ovary posttesticular; vitellaria dendritic, postovarian; uterus preovarian.

Both *Halipegus,* Looss, and *Derogenes,* Luhe—especially the latter—show affinities with the new subfamily, though the form of the vitelline glands differs in each case, being dendritic in *Isoparorchis,* rounded in *Derogenes,* and composed

of a few short rounded lobes in *Halipegus*. It is of interest to note that Luhe (1909) placed these two genera in the vicinity of the Dicrocoeliinae and Hemiuridae, whereas Pratt (1902) included *Derogenes* in the latter and regarded *Halipegus* and *Accacoelium* as related to the Syncoeliinae. Nicoll (1910, p. 348) seems to have been in doubt regarding the systematic position of *Derogenes*, as he listed it under "subfamily (Derogeninae)," though he subsequently (1914, p. 487) placed it under the Syncoeliinae, as also did Manter (1926, p. 100). The absence of a cirrus sac in *Halipegus*, and the presence in *Derogenes* of a muscular organ surrounding the ends of both male and female ducts, as in *Isoparorchis*, should be noted.

Tandanicola bancrofti, n. gen., n. sp.

B. Figs. 1-5.

This semi-transparent trematode was collected from the gas bladder of *Tandanus tandanus*, from the Burnett River, at Eidsvold, by Dr. Bancroft and his daughter, Dr. J. M. Mackerras, while Mr. H. Tryon forwarded some from the same host species from the Condamine River, near Warwick, Queensland.

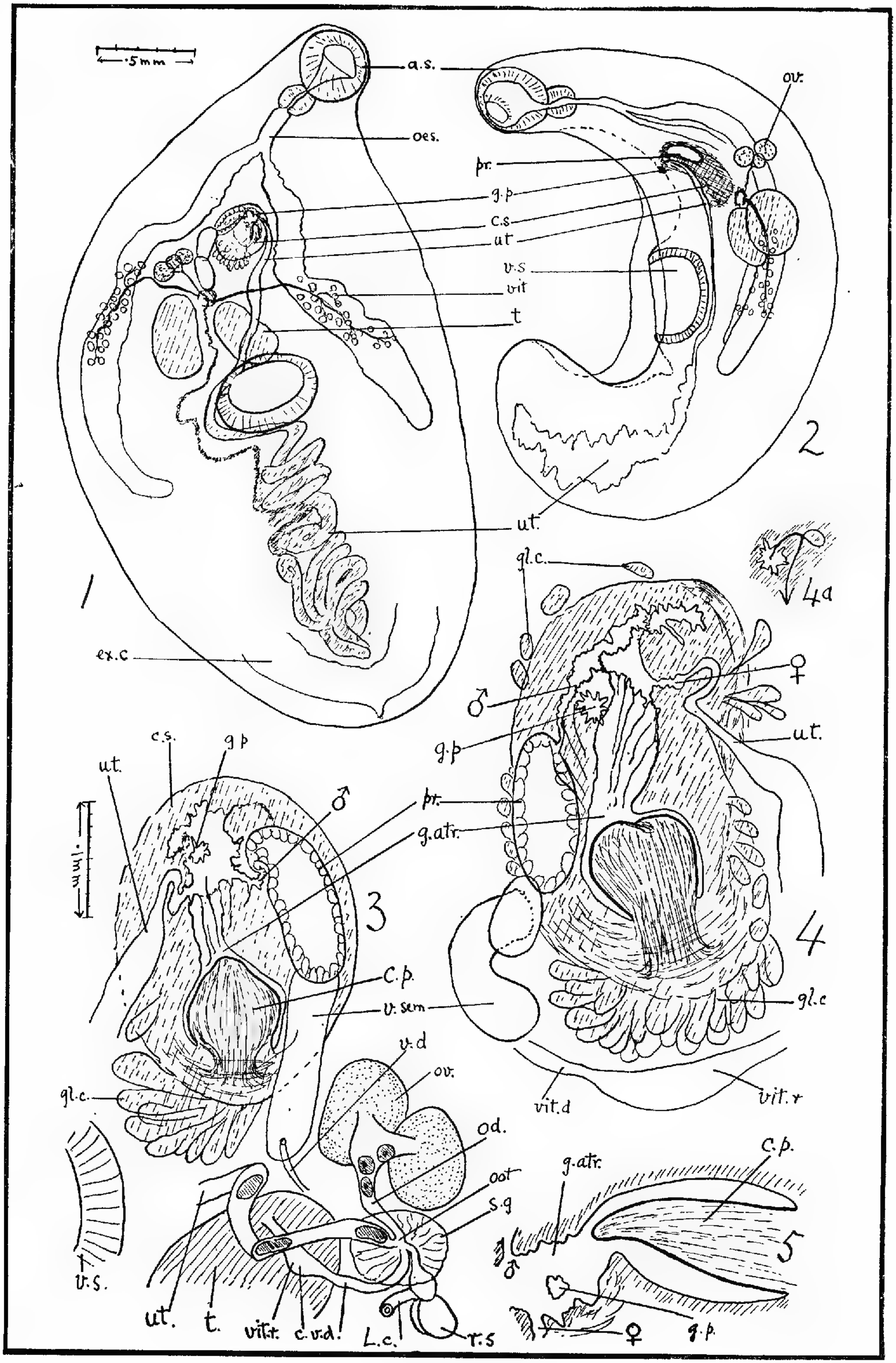
Preserved specimens are very pale, strongly flexed ventrally, the oral sucker more or less underlying the acetabulum, and the posterior end may also be bent somewhat ventrally, while the lateral edges may be slightly inturned. The largest specimen, when slightly compressed, measured about 3·8 mm. in length by 2 mm. in breadth, the greatest width being in the vicinity of the acetabulum, which is situated in the midbody. The anterior end narrows somewhat, but the posterior is rounded. The mouth is subterminal. Both suckers are well developed, especially the ventral, their respective diameters being 0·38 mm. and 0·48 mm., the ratio being about 4 : 5. The cuticle is smooth, except anteriorly, where it is very minutely scaly (under high power).

The pharynx, which has a diameter of about 0·17 mm. and a length of about 0·15 mm., is succeeded by an oesophagus 0·2 mm. to 0·3 mm. long; the latter branching into the two intestinal crura, which are fairly even in diameter and extend only slightly beyond the acetabular level. The inner portion of each crus may be somewhat crinkled.

The excretory canals form a U with very long, wide limbs with sacculate walls and extending anteriorly almost to the pharynx, and lying laterally from the intestinal crura. The pore is terminal.

The testes are slightly elongate, nearly elliptical, measuring 0·4 mm. by 0·22 mm., lying side by side, being separated by the uterine canal. They are situated just in front of the acetabulum, whose anterior border they may partly overlie. There is a prominent elongate swollen vesicula seminalis on the right of the median line, extending from the region of the shell gland forwards beside the ovary, between the latter and the genital sac. It may underlie portion of the ovary, while its anterior region is closely adjacent to and may partly overlie the sac. It then enters the latter to become a rather wide elongate rounded structure with markedly glandular walls, presumably constituting a prostatic region. There arises a very short duct from its anterior end to terminate in a strongly-folded pouch lying in anterior portion of the genital atrium, some distance in front of the papilla. The arrangement of the various parts is somewhat like that occurring in *Levinseniella*.

The genital sac is a conspicuous organ whose size varies in different specimens (0·15 mm. long by 0·13 mm. broad; 0·4 mm. by 0·2 mm.). It possesses abundant longitudinal and circular muscle fibres, while its exterior is provided with numbers of large cells which are especially numerous around the posterior end of the organ. They appear to be glandular. Projecting into the lumen of the sac is a very prominent copulatory papilla which is not traversed by the male duct. It varies in form in the different specimens examined, being broadly


·5 mm
a.s.
oes.
pr.
g.p
c.s
ut
v.s
vit
t
ov.
ut.
ex.c
1
2
gl.c.
4a
♀
♂
g.p
ut.
pr.
g.atr.
c.s.
ut.
3
4
c.p.
v.sem
gl.c
v.d
ov.
gl.c.
od.
oot
s.g
vit.d
vit.r
g.atr.
c.p.
5
v.s.
ut.
t.
vit.r.
c.v.d.
L.c.
r.s
♀
g.p.

B. Figs. 1-5.

rounded in some and more or less conical in others (0·08 mm. long by 0·09 mm.; 0·08 mm. by 0·08 mm.; 0·18 mm. by 0·07 mm., an elongate conical form), according to the degree of retraction. Its cavity contains abundant longitudinal muscle fibres inserted into the tip of the organ, while the surrounding copulatory sac is richly supplied with circular muscle fibres. The lumen of the atrium varies in dimensions according to the degree of retraction of the papilla; but its walls, like those of the papilla, are very strongly chitinised. They are also thrown into a series of very prominent longitudinal or spiral ridges when the papilla is retracted. The lumen is not straight, the outer part being bent or twisted more or less spirally, and projecting anteriorly to the genital pore which partly underlies the sac. Into the anterior part of the atrium there enter the uterus (metraterm) and the ejaculatory duct adjacent to a strongly folded pouch-like part of the wall in each case. The genital pore lies in the midline about midway between the two suckers, and is an insignificant aperture when the papilla is fully retracted. It then has strongly infolded walls like those of the atrium, but when the papilla is protruded through it, the lumen becomes more circular. The pore possesses a strong sphincter.

The ovary consists of three larger and one or two smaller rounded vesicles, some of which partly overlie others, the organ being situated on the right side in front of the right testis and between the intestine and vesicula seminalis, sometimes overlying part of the latter and of the genital sac. The oviduct travels inwardly and somewhat posteriorly towards the midline, to receive the common yolk duct or reservoir, then passes upwards to enter the shell gland, which measures 0·8 to 0·13 mm. in diameter. The latter lies ventrally to the yolk reservoir and is situated between, or just in front of, the anterior borders of the testes. Laurer's canal arises ventrally, immediately before the oviduct enters the shell gland, and curves around the latter dorsally as a very delicate tube which becomes swollen into one or more receptacula seminis and then fairly long and canal-like. The ootyp continues backwards in a slightly undulating course as a narrow uterine duct, at first above the shell gland and later lying between the testes or below one of them, thence above or to one side of the acetabulum, behind which it becomes widened into the uterus. The latter is thrown into a series of loops and coils occupying the midregion of the postacetabular part of the parasite, excepting the posterior end. The duct eventually travels forwards as a fairly wide canal above the acetabulum or to one side of it, thence below the left testis and vitelline duct, and then on the left side of the genital sac to terminate as a narrow tube opening into a cuticular pouch in the anterior part of the atrium. Eggs are thin-shelled, abundant, and measure 0·042 mm. by 0·025 mm. (uterine eggs, 0·032 mm. by 0·025 mm.).

The yolk glands lie laterally in the second quarter of the worm and consist on each side of 20 to 30 follicles, lying directly above the intestine. They are on approximately the same level as the testes, being preacetabular and postovarian. The main duct from each side passes directly inwards into the anterior border of the corresponding testis, the two ducts meeting just above the shell gland. They may overlie the ventral lobe of the ovary, the uterus, and the posterior part of the vesicula seminalis, but are ventral to the main mass of the ovary. The

---

DESCRIPTION OF TEXT FIG. B.

References to the lettering will be found at the end of the article.

Tandanicola bancrofti.

Fig. 1: Entire worm, ventral view. 2: Entire worm, lateral view. 3: Female organs (in part), also copulatory sac, etc., from a teased specimen. 4: Copulatory sac, etc. 4*a*: Sketch to indicate course of genital atrium from genital pore. 5: Another form of copulatory papilla, less retracted than those indicated in figs. 3 and 4.

Figs. 1 and 2 are drawn to scale indicated beside fig. 1; figs. 3, 4, and 5 to scale drawn beside fig. 3.

united duct may be swollen to constitute a vitelline reservoir which narrows immediately before joining the oviduct as it enters the shell gland.

In several specimens amphitypy was observed, the ovary, shell gland, and terminal portion of the uterus being on the left of the median line, instead of the right.

The general topography of the organs indicates that the worm belongs to the Brachycoeliidae, as diagnosed under subfamily title by Luhe (1909, p. 118). The absence of a typical cirrus sac and the position of the ovary and testes exclude it from Brachycoeliinae (s. str.). Though the Phagicolinae are devoid of a cirrus sac, yet the positions of the other organs prevent the inclusion of the parasite in that subfamily, and this remark would apply to the Lecithodendriinae. The parasite seems to be more nearly related to the Microphallinae in regard to the structure of the cirrus sac (Ward, 1901; Luhe, 1909), but the postacetabular position of all organs except the uterus and genital sac in the subfamily definitely eliminates the Australian parasite from it. A new genus *Tandanicola* and subfamily Tandanicolinae are therefore proposed for its reception, the following provisional generic diagnosis being suggested. *Tandanicola,* n. gen., Brachycoeliidae: Cuticle more or less minutely spiny; suckers well developed; prepharynx absent; pharynx and oesophagus present; intestinal crura extending to vicinity of acetabulum; testes compact, lying at same level, preacetabular, postovarian; ovary consisting of a few rounded lobes, pretesticular; cirrus sac absent, replaced functionally by a muscular copulatory sac with well-developed copulatory papilla; genital pore preacetabular; vitellaria consisting of comparatively few follicles, lying laterally above intestinal crura, preacetabular; uterus mainly postacetabular, restricted to midregion; excretory vesicle practically U-shaped. Type, *T. bancrofti.*

References to lettering: *a.s.*, anterior sucker; *c.p.*, copulatory papilla; *c.s.*, cirrus sac; copulatory sac; *c.v.d.*, common vitelline duct; *d.h.*, ductus hermaphroditicus; *ej.d.*, ejaculatory duct; *ex.c.*, excretory canal; *ex.v.*, excretory vesicle; *g.at.*, genital atrium; *gl.c.*, gland cells (?); *gl.int.*, glandular region of intestine; *g.p.*, genital pore; *int.*, intestine; *L.c.*, Laurer's canal; *od.*, oviduct; *oes.*, oesophagus; *oot.*, ootyp; *ov.*, ovary; *ph.*, pharynx; *pr.*, prostatic portion of male duct; *r.s.*, receptaculum seminis; *s.g.*, shell gland; *t.*, testis; *ut.*, uterus; *v.d.*, vas deferens; *v.eff.*, vas efferens; *vit.*, vitelline glands; *vit.d.*, vitelline duct; *v.r.*, vitelline reservoir; *v.s.*, ventral sucker; *v.sem.*, vesicula seminalis.

Literature References.

1926—Bhalerao, G. D.: "On the Synonymy of the Genera *Isoparorchis,* etc." Ann. Mag. Nat. Hist., 17, pp. 246-250.

1914—Johnston, T. H.: "Notes and Exhibits, Trematoda." P.R.S. Q'land, 26, p. 69.

1916—Johnston, T. H.: "Census of Endoparasites recorded as occurring in Queensland, etc." P.R.S. Q'land, 28, pp. 31-79.

1920—Kobayashi, H.: "On some Digenetic Trematodes in Japan." Parasitology, 12, pp. 380-410.

1909—Luhe, M.: "Trematoda," in Susswasserfauna Deutschlands, 17.

1926—Manter, H. W.: "Some North American Fish Trematodes." Ill. Biol. Monogr., 10 (2).

1910—Nicoll, W.: "On the Entozoa of Fishes from Firth of Clyde." Parasitology, 3, pp. 322-359.

1914—Nicoll, W.: "Trematode Parasites of Fishes from the English Channel." Jour. Mar. Biol. Assoc., 10, pp. 466-505.

1901—Ward, H. B.: "On the Structure of the Copulatory Organs in *Microphallus.*" Tr. Amer. Micr. Soc., 22, pp. 175-187.

ABORIGINAL ROCK SHELTERS AND CARVINGS—THREE LOCALITIES ON THE LOWER MURRAY.

By Harold L. Sheard.

[Read July 14, 1927.]

The first of the rock carvings and shelters herein described, namely, the Wongulla Series, was discovered on a recent trip to the Murray in company with Messrs. C. P. Mountford, P. Stapleton, and N. B. Tindale. At their joint request, I undertook the recording of this discovery. A second visit was made in company with Mr. Mountford, when the Wongulla Series was found to be more extensive than at first supposed, and two further occurrences were discovered at Fromm's Landing at Scrubby Flat. A subsequent trip with Mr. Tindale allowed further investigations at Fromm's Landing.

In a previous paper (1) the author recorded a series of aboriginal intaglios at Devon Downs (Section 89, Hundred of Nildottie). These markings cover practically the whole available surface on a rock shelter 70 feet in length; those recorded in this paper, while similar in technique, cover much smaller rock surfaces, but extend over a much wider field and embrace several new designs.

The Wongulla Series.

This includes three shelters and intermittent markings on the cliffs at various points. The locality is opposite the Wongulla Landing, and extends on the eastern side of the Murray for about a quarter of a mile in Sections B and C, Hundred of Forster. Wongulla is about two miles south of Devon Downs, following down stream.

The river here has a north and south direction, and a mud flat, about a mile long and a quarter of a mile wide, extends along the eastern side. This is sometimes covered with water, forming a billabong, and is bounded on the eastern extremity by the cliffs, which rise sheer, for about 200 feet, from a bank which is fringed with tall gum trees and undergrowth, giving protection to the rock dwellings which have weathered out at the base of the cliffs. These appear to have been much occupied by the aborigines. In places large blocks of rock have fallen from the cliffs and encumber the banks.

The cliffs are formed of a fossiliferous limestone laid down in Miocene times. This can be readily scratched or marked with any hard implement, and forms a suitable background for the native art.

Starting at the northern end, the first markings noted are a number of short straight line cuts, varying from 3 to 7 inches in length, mostly perpendicular, but sometimes being crossed by oblique cuts forming double crosses. Characteristic bird tracks (singly and in short connected rows) and fern frond-like designs were also observed. This area is 5 feet in length and is situated directly on the cliff face about 3 feet high.

A hundred yards further south is the first shelter showing definite signs of occupation. This is 30 feet in length, with an overhang in the widest place of 12 feet. The present height at the entrance is 10 feet and curves down to meet the floor. It is 25 feet above the level of the billabong, and the highest flood on

(1) Sheard, Trans. Roy. Soc. S. Austr., 1927, p. 18.

record did not wash the floor, although other shelters near it were inundated. The walls and roof are smoke-blackened, and a grey smoke stain ascends the cliffs lodging thickly on every ledge. The floor is composed of a bed of ashes and detritus 3 feet in depth.

The ashes on being examined show a tendency to banding which would suggest intermittent periods of occupation. Fragments of hammerstones, rough quartz chippings, and bones of the Murray cod *(Oligorus macquariensis)* were discovered, and bivalve shells *(Unio angasi)* were numerous. Two roughly flaked quartzite stones were also found, and these reproduced exactly the markings and holes when scratched or bored against the cliffs.

The main group of markings occupies an area of 11 feet by 3 feet 6 inches on the curving wall of the shelter, about 7 feet above the floor. A complicated intaglio measures 23 inches by 29 inches. A portion of this has weathered at the lower end. A semicircular design situated slightly above this measures 12 inches long by $7\frac{1}{4}$ inches wide. Three inverted V-shaped markings bisected by a longer line measure 7 by 6 by 12 inches, 5 by 5 by 9 inches, $6\frac{1}{2}$ by 5 by 8 inches, respectively. These are all new designs, nothing similar having been previously observed. A characteristic row of round holes borders this series on the lower side. This contains thirty-eight holes, some of which are connected. They vary from three-eighths to 1 inch in diameter and from a half to 1 inch in depth. Other short series of holes, including double rows, were also observed.

For the following six chains or so along the cliff only occasional intermittent markings and scratches of little consequence were noticed.

The second shelter is then reached. The roof in this is only about 3 feet in the highest place, and the entrance extending for about 20 feet was merely 12 to 15 inches in height. It was interesting to observe on the northern wall the cuttings figured by Hale and Tindale.(2)

Several rows of holes, straight-line cuts, and a few tracks were also noticed. As is usual, in all these shelters ashes and *débris* formed the floor, and the rocks were much smoke stained.

Three chains further south another shelter was located. This was from 3 to 5 feet in height, about 12 feet deep, and approximately 25 feet long, the roof being supported in the centre by a column of rock which had withstood the action of the weather.

Every available space on this column was decorated chiefly with round holes arranged in a variety of patterns and designs, but scratches, straight-line markings, irregular crosses, and bird tracks were present. Similar markings and patterns existed in the shelter.

A few chains further south the main channel of the river curves in and washes the base of the cliffs. The intervening space contains, at intervals, numerous markings, but nothing different from what has already been described.

Notes on Shelters at Fromm's Landing.

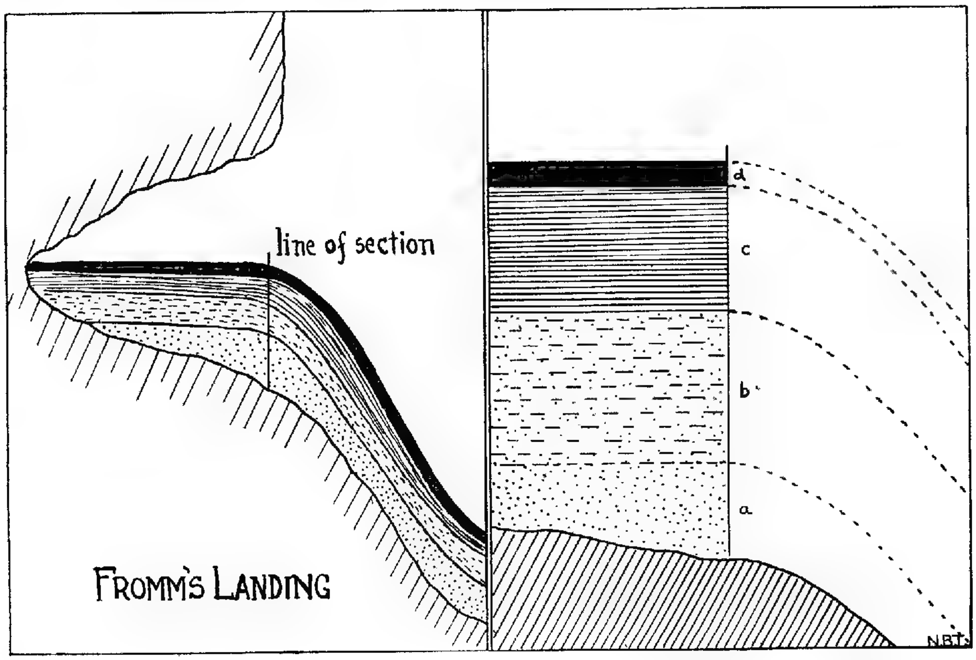
This is situated on Section 302, Hundred of Ridley, on the western bank of the river about five miles below Wongulla. A mud flat and billabong, similar to but more extensive than those at Wongulla, extend along the western side of the river. This is bounded by the cliffs, which have the usual bank at their base.

The cliffs here are about 100 feet high, and weathering (possibly when the river was at a higher level) has eroded several shelters. One is 90 feet in length

(2) Hale, H. M., and Tindale, N. B., Records of South Australian Museum, iii., 1925, pl. 4, fig. 4.

and 5 feet 6 inches in height at the entrance, extending under the cliffs for about 12 feet. This is the largest shelter that has yet been observed by the author in any locality on the Murray, and singularly, except for a few round holes on the northern end and a few doubtful markings, contains no carvings.

This shelter bears every indication of a very long occupancy. A continuous bed of ashes and *débris* extends the whole length, and appears to be much deeper than usual. The bank is also deeply covered with ashes. Allowing for the removal of ashes by the occupants, also the natural action of the wind (and this is considerable, as the floors are invariably very dry and dusty), a very long period must have transpired since this shelter was first tenanted. Further, a thick pall of smoke has blackened the rock surface, and even the holes referred to were practically filled with soot. It is possible that were some of this matter removed, scratches may be visible. The shelter faces due east and the bank being well overgrown, efficient protection would be obtained in all weathers.



As our time was limited only part of this locality was examined. The author remembers observing (when passing this district by boat several years ago) a few fern-like markings on the cliffs about a mile to the south of this shelter.

On a subsequent trip to Fromm's Landing, Mr. Tindale obtained a section from the floor deposits of the large shelter described above. As nothing of this type has been previously published, this is included as being typical of many Murray shelters (see text fig.).

The deposits at the entrance total 6 feet 4 inches, resting on the Miocene rock. The first 17 inches (marked *a* in figure) consist of sterile sand weathered from the cliff. Above this was 30 inches *(b)* of intermittent layers of burnt sand and charcoal. This abruptly changed to 25 inches *(c)* of continuous ashes, etc., showing regular banding, the whole being covered with 4 inches *(d)* of recent disturbed ashes and *débris*.

At 26 inches from the base rock a fragment of burnt slate, and at 24 inches a piece of coarse granite were obtained, both of which are foreign to this locality.

Three chains up-stream a shelter was located, at the entrance of which scratchings were observed. These consisted of bird tracks singly and connected, straight-line cuts, and round holes, but were not numerous.

The Scrubby Flat Series.

This locality is in Section H, Hundred of Forster, and is situated on the eastern bank of the river slightly north of Fromm's Landing. A mud flat borders the river, at the northern end of which the landing is situated. A few chains further north the main channel encroaches on the cliffs.

The intervening space is filled with the ragged end of the cliff much broken and distorted. This creates several small shelters, one of which was crowded with carvings. This shelter was approached by climbing over a rough boulder-like formation and measured 12 feet in length, the overhang being about 6 feet and the roof 8 feet high.

A leaf-shaped design differed from those previously observed; it is 10 inches wide and 16 inches in length, and is bisected and crossed by oblique lines radiating from a round hole in the centre. This hole is 4 inches deep and 1½ inches in diameter.

An unusual A-shaped design is apparent. This type has not been previously observed, and may be due in part to vandalism. Both these designs appear to have been partly re-cut with steel tools. A fern-like design and many other cuttings were observed. This shelter is situated beyond flood level, and the *débris* of the floor yielded kernels of the native peach *(Santalum acuminatum)*, bones of the Murray cod, animal bones, and many *Unio* shells. A hammerstone was also found at another point. Smoke stains occur throughout this and other shelters and on many faces of the rocks. Some of the fallen rocks bear markings, and in many places about the cliffs intermittent cuttings were seen. Just before the river is reached, low down on the cliffs, several marks of the straight-line type were observed, these being much weathered, probably by water, and all show smooth rounded edges.

Conclusion.

Three new localities, each containing shelters decorated with a comparatively recently recorded type of aboriginal markings, have been described, and several new designs noted. A typical section of the *débris* from the floor of one shelter is included.

I desire to acknowledge the assistance of my three colleagues; only their insistence has made me the sole recorder of these discoveries.

OBSERVATIONS ON A NEW-BORN AUSTRALIAN ABORIGINAL INFANT.

By J. B. Cleland, M.D., and Cecil J. Hackett.

[Read July 14, 1927.]

Plates VII. and VIII.

Through an arrangement kindly made by Mr. F. Garnett, Chief Protector of Aborigines, a pure-blooded aboriginal woman who was expecting her confinement was transferred from Point McLeay to Adelaide. On arrival she was taken direct to the Queen's Home, and after two or three days' retention there to enable measurements to be taken and observations made, she was sent down to await the onset of labour at a Home in North Adelaide. At about 10 o'clock on Sunday night, May 22, labour commenced and she was re-admitted to the Queen's Home. The abdomen was of enormous size, the patient herself being a rather stout woman. At 5 a.m. the next morning labour was in progress, and one of us was notified by telephone. In spite of vigorous pains progress was slow. The presentation was found to be a right occipito-posterior, which was rectified. Forceps had finally to be applied by Dr. Bernard Dawson, under whose care the patient was. Difficulty was found with the head, and still greater difficulty was experienced in delivering the shoulders, and even the breech stuck to some extent. These difficulties were almost entirely due to the large size of the baby, whose weight at birth was 12¼ lbs., and the length 25 inches. The child was still-born, due apparently to the delay and difficulties attendant on the birth. A full obstetrical account will be published elsewhere, the present paper dealing merely with the characteristics of the infant, which was of full-blood. The parents belonged to the tribes inhabiting the Lower Murray. Observations were commenced immediately after delivery, but more detailed ones, together with the matching of colours, were made about four hours later. A water-colour sketch could only be made on the succeeding day, the infant being meanwhile kept in the freezer. The specimen has been preserved by injections and, together with the placenta and cord, is in the custody of the Pathology Department of the University.

The infant was an exceptionally large male child in a good state of nutrition. The weight, 12¼ lbs. (5·556 kilos.), and the height, 25 inches (63·5 cm.), indicate the unusual size. This is of exceptional interest, owing to the difficulty experienced in delivery. With expert attention in an up-to-date hospital, the child died. In the country, at a distance from early medical attention, a result fatal to the mother might have occurred. In a savage state the death of the mother would have been almost inevitable. In the absence of any skilled obstetrical attention whatsoever over a period of many thousands of years, one would have expected that natural selection in our aborigines would have eliminated almost entirely the occurrence of infants of such a size as to render their delivery difficult or impossible. It seems hardly likely that the civilised conditions in which this woman was living could account for the unusual size of the baby. Possibly she may have been a month over her time, and she was certainly a fortnight later than had been expected, but even this would not account for the whole of the increase in the size. Evidently from time to time amongst the Australian aboriginals unduly large newly-born children do occur still, in spite of the efforts of natural selection to eliminate them.

General Observations.—The face was plump with well-marked cheeks, and a deep groove ran transversely across the somewhat squat nose at the level of the

nasion. The eyelids and lips were closed. On opening the eyelids the iris was seen to be of an earthy-brown colour, partly obscured by a bluish haziness which appeared to be in the tissues in front. On parting the slightly pigmented lips the gums were seen to be pale and prominent as if teeth were immediately sub-adjacent. The chin formed a rounded prominence with a sulcus surrounding its upper aspect. The lobule of the ear was well-marked, rounded, and free. The vault of the skull, compared with that of a full-term white infant, felt unduly resistant to compression, no well-marked bridge of soft tissue being palpable along the region of the sagittal suture. The anterior fontanelle measured, roughly, 2 x 1·5 cm. Over the left occipito-parietal region was a moderate caput succedaneum. Apart from the usual skin creases about joints, two other sites were readily noticed. There was one sulcus on each forearm just below the middle of the flexor surface, which was deep on the radial side but faded out on the ulnar margin. The other sulcus was at the junction of the middle and lower thirds of the thigh on the inner aspect. The hands were of the simian type, that is, the second longest digit was the ring finger. The second digit of the foot was the longest. The nails projected beyond the nail-bed by about 1 mm. The skin creases on the palms and soles are well shown in the accompanying photographs. There was a well-marked inter-spinous crease on the abdomen.

Pigmentation.—The general colouration of the skin was at once noticed at birth as presenting a light cyanotic tinge (near Avellaneous, Vinaceous Buff, Ridgway's Colour Index, pl. xl.). Pressure had no effect on it. This was emphasised by certain parts being markedly pigmented. At the junction of the skin with the amniotic covering of the cord was a pigmented ring about 3 mm. in width, the colouring being most marked at the junction line. Around each nipple was an area of sooty pigmentation (Fuscous Black, pl. xlvi.) 7 mm. in diameter. The skin of the scrotum, penis, and prepuce showed a dark pigmentation with a vinous tinge (more Vinaceous than Fuscous Black, pl. xlvi.). The prepuce was fairly long and the glans was exposed with difficulty. The mucous lining of the prepuce and glans showed a reddish colouration. There was slight pigmentation in both axillae indefinite in outline. The hands and feet, and especially the palms and soles, were very pallid (Tilleul Buff, pl. xl.). The limbs appeared more dusky than the trunk, perhaps due to the presence of more hair on the former. It was thought that the pigmentation had become somewhat darker or duskier some hours after birth, but no definite statement can be made that this was so. The sacral region was not pigmented.

Hair.—On the scalp the hair was black and varied in length up to 5 cm. Many of the tresses showed more than a complete circle or curl towards their distal end, the circle having a lumen that would close on a slate-pencil. The remainder showed an open deep wavy curve. Finer and shorter hairs occurred on the forehead, their direction being downwards in the midline, and laterally horizontally outwards parallel with the eyebrows. These hairs contributed to the duskiness of the forehead. Fine hairs covered the well-developed ears. There were a few fine hairs in the parotid region in front of the ears and on the sides of the face.

On the trunk there was more hair on the dorsal aspect where its general direction was from the flanks inwards towards the midline, curving down slightly when approaching the spine. In the sacral region this direction was less definite. On the anterior aspect of the thorax the hair ran downwards and inwards in a curved direction tending to surround the nipple. There was but scanty hair on the abdomen. With the arm by the side, the hair appeared to radiate forwards from the posterior axillary fold over the shoulder and deltoid region and down the arms. There was more hair on the external aspect of the arm and forearm than on the inner side. With the thigh at right-angles to the trunk, the direction of the hairs on it seemed to radiate from the anterior superior iliac spine to the natal

New-born Australian Aboriginal Infant.

Gillingham & Co. Limited, Printers, Adelaide

New-born Australian Aboriginal Infant

Gillingham & Co. Limited, Printers, Adelaide.

cleft and down the thigh anteriorly. Below the knee the direction was downwards. The inner aspect of the thigh and leg was relatively free from hair.

The following measurements were taken:—

Vertex to heel (with tape)	63·5 cm.	Nose—Breadth	2·7 cm.
Occipito-mental	13·5 ,,	Height	1·9 ,,
Occipito-frontal	12·0 ,,	Ear—Height	5·2 ,,
Suboccipito-bregmatic ..	9·5 ,,	Breadth	2·9 ,,
Biparietal	9·5 ,,	Minimum inter-canthal	2·3 ,,
Bitemporal	8·5 ,,	Maximum inter-canthal	6·6 ,,
Fronto-temporal	8·5 ,,	Vertex to rump	41·0 ,,
Cervico-bregmatic ..	11·5 ,,	Hand—Length	6·9 ,,
Menton-crinion	9·2 ,,	Breadth	4·0 ,,
Menton-nasion	5·2 ,,	Foot—Length	9·2 ,,
Mouth—Breadth	2·9 ,,	Breadth	3·4 ,,
Height	1·1 ,,		

The Cord and Membranes.—The cord measured 73 cm. in diameter and became smaller in section as the placenta was approached from the foetus, being 2·5 cm. in diameter near the foetus, and near the placenta before it divided 1·5 cm. Within about 7 cm. of the placenta a branch came off at right angles to the cord, and this and the main stem each divided into three rather tortuous series of vessels which eventually ramified over the placenta from the lateral attachment, that is, the placenta was of the battledore type. No pigmentation of the cord or membrane was observed.

The Placenta.—This measured 20 cm. x 2·5 cm., and was roughly circular. Its chorionic aspect showed gross lobulation and a couple of small infracted areas the size of marbles.

The Liquor Amnii.—No actual measurement of this could be taken, although an attempt was made. As far as could be judged only a slight excess, if any, was present. Meconium was mixed with it even in the waters first passed, and the result was a greenish-brown discolouration. Miss Long found the presence of abundant bile pigment in the liquor.

Blood was collected from the mother and from the foetal end of the cut umbilical cord. Unfortunately citrate solution was not at the moment available so as to be able to use the red cells for testing purposes. The serum that separated showed that the mother belonged to Group IV. of Moss' Classification, as this serum caused clumping of red cells belonging to Groups II. and III. The separated serum of the infant, on the other hand, did not agglutinate the red cells of either of these Groups even under the microscope. It cannot be inferred from this, however, that the infant belonged to Group I. of Moss' Classification—a Group that we have not yet met with amongst the Southern Australian aboriginals. It would appear that it is some time after birth before the blood-grouping of the infant can be decided.

We would like to express our indebtedness to Mr. Garnett, Chief Protector of Aborigines; to Dr. Bernard Dawson, the Honorary Medical Officer in charge of the case; to Dr. Wallace, R.M.O.; and to the Matron of the Queen's Home, for the facilities they have granted us and for their interest in this aboriginal birth.

DESCRIPTION OF PLATES VII. and VIII.

Photographs in various positions of the Aboriginal Infant showing the General Appearance, various Skin and Subcutaneous Creases, and the contrast between the general Pallid Colour and such deeply Pigmented Areas as the Nipples, Scrotum and Ring round the Umbilical Cord.

THE CLAWLESS AND APPARENTLY CLAWLESS CURCULIONIDAE OF AUSTRALIA.

By Arthur M. Lea, F.E.S.
(Contribution from the South Australian Museum.)

[Read August 11, 1927.]

A singular feature that occurs in several genera of several subfamilies of Australian Curculionidae, is the absence, or apparent absence, of the claw joint, so that each tarsus consists of but three joints, with the third wider than the others, its apex completely rounded, and the fourth joint truly absent; or the tip of the third may be slightly notched at the apex, and with or without a rudiment of the fourth joint in it.

The apparent or real absence of the claw joint is often accompanied by the loss of a joint in the funicle, this being six-jointed instead of seven, or even *(Anarciarthrum)* five-jointed. Other genera of weevils, however, have less than seven joints in the funicle but with normal tarsi; *Cionus* five-jointed, many Cossonides with five or six joints, or even *(Dryopthorus)* four.

Of the genera, *Misophrice, Anarciarthrum,* and *Micraonychus* occur on plants of the genus *Casuarina* (sheoaks and bulloaks), *Syarbis, Aolles, Zeopus, Atelicus,* and *Thechia* on species of *Eucalyptus* (gum trees), and *Aonychus* on species of *Hakea* (needle-bushes) and *Atriplex* (salt-bushes). *Geochus* occurs under fallen leaves.

The previously described species are as follows:—

GONIPTERIDES.

Syarbis, Pasc. *(Acroteriasis,* Roel.).

albivittis, Lea
alcyone, Lea
deyrollei, Roel.
emarginatus, Roel.
eucalypti, Lea
fasciculatissimus, Lea
gonipteroides, Pasc.
goudiei, Lea
haagi, Roel.
    plumbeus, Lea
    sciurus, Pasc., var.
nervosus, Pasc.
niger, Roel.
plumbeus, Lea
nubilus, Roel.
    brevicornis, Lea
pachypus, Pasc.
porcatus, Lea
posthumeralis, Lea
pulchellus, Lea
pulchripennis, Lea
punctipennis, Roel.
sciurus, Pasc.
semilineatus, Pasc.
simulans, Lea
subnitidus, Roel.

DIABATHRARIIDES.

Atelicus, Waterh.

abruptus, Pasc.
atrophus, Pasc.
crassipes, Pasc.
ferrugineus, Waterh.
guttatus, Pasc.
inaequalis, Waterh.
miniatus, Pasc.
variabilis, Lea

ERIRHINIDES.

Misophrice, Pasc.

alternata, Lea
amplicollis, Lea, vars. A, B, C
amplipennis, Lea
apionoides, Lea
argentata, Blackb.
arida, Lea
blackburni, Lea
brevisetosa, Lea
carteri, Lea
clathrata, Lea
cristatifrons, Lea
cylindrica, Lea
dispar, Blackb.
dissentanea, Lea
dubia, Lea
evanida, Lea
fenestrata, Lea
gloriosa, Lea, vars. A, B, C, D, E, F
griffithi, Lea
hispida, Pasc.
hobleri, Lea
inconstans, Lea
inflata, Lea
insularis, Lea
minima, Lea
munda, Blackb.
nigriceps, Lea
nigripes, Lea, vars. A, B, C
nigriventris, Lea
oblonga, Blackb.
orthorrhina, Lea
parallela, Lea
quadraticollis, Blackb.
rufiventris, Lea
setosa, Lea
setulosa, Blackb.
soror, Lea
spilota, Blackb.
squamibunda, Lea
squamiventris, Lea, vars. A, B
squamosa, Blackb.
submetallica, Blackb.
tuberculata, Lea
v-alba, Lea
variabilis, Blackb.
vicina, Lea
viridisquama, Lea
vitiata, Lea

Anarciarthrum, Blackb.

viride, Blackb.

Thechia, Pasc.

alternata, Lea (? *Cenchrena)*
bimaculata, Lea
brevirostris, Lea
cinerascens, Lea
latipennis, Lea
longirostris, Lea
pygmaea, Pasc.

HAPLONYCIDES.

Aolles, Pasc.

longirostris, Lea
minimus, Lea
moestus, Lea
nuceus, Pasc.
orbiculatus, Lea
ornatipennis, Blackb.
puncticollis, Lea
rubiginosus, Pasc.
tibialis, Lea
trifasciatus, Lea
uniformis, Lea
variegatus, Lea

Zeopus, Pasc.

storeoides, Pasc.

CRYPTORHYNCHIDES.

Aonychus, Schon.

argus, Lea
hopei, Boh.
var. *bicruciatus,* Lea
lineatus, Pasc.
luctuosus, Pasc.
pachypus, Pasc.
striatus, Lea

MICRAONYCHUS, Lea.

CASUARINAE, Lea
CINERASCEUS, Lea
DECIPIENS, Lea
MACULATUS, Lea
NIGRIROSTRIS, Lea
RUFIMANUS, Lea
SORDIDUS, Lea

ATELICUS.

In a note on *Strongylorrhinus* Waterhouse [1] comments as follows on two species of *Atelicus*:—"In the total absence of claw joint to the tarsi. Here the large dilated third joint to each tarsus is entire, showing neither the apical notch, nor the groove on the upper surface." In his diagnosis of *Atelicus* he notes "*tarsis triarticulatis . . . articulo tertio fere rotundato.*" In the description of *A. inaequalis* and *A. ferrugineus* the third joint was not mentioned. The former species being the first described is presumably the type of the genus, and was so accepted by Lacordaire, who wrote of its tarsi [2] "*3e article des tarses orbiculaire, le 4e nul*"; in the figure [3] the tarsi are also shown as three-jointed. Lacordaire correctly described the funicle as being composed of six joints with the following one contiguous to the club, in fig. *2b*, however, it is shown as seven-jointed.

There are before me several specimens from Tasmania that agree so well with the characters noted by Waterhouse, except in the tarsi, that I think they must belong to *A. inaequalis*. A similar specimen from Victoria bears Blackburn's name label "*inaequalis*, Waterh.," and there are others before me from New South Wales. The tarsi at first glance appear to have the third joint entire and to be without a claw joint, but on close examination the third joint on each tarsus is seen to have a thin wedge-shaped notch extending almost half-way to the base, the notch completely occupied by a claw joint, which is covered with similar clothing to that of the adjacent surface; claws, if present, are obscured by the apical fringe.

Specimens identified by Blackburn and myself as *A. ferrugineus* have somewhat similar tarsi, but the clothing of their upper surface being more closely compacted the claw joint is even less distinct, and on some specimens is scarcely indicated on close examination. In fact, the tarsi on all species of the genus appear to be three-jointed, but on close examination a claw joint or remnant of same becomes visible. It is probable, however, that it could not be seen when the tarsi are mealy or greasy.

ATELICUS INAEQUALIS, Waterh., var.

A specimen from Tasmania appears to represent a variety of this species; its elytra, from the base almost to the subapical tubercles, are clothed with uniformly whitish scales, having in some lights a golden gloss; just before the subapical tubercles and on the apical declivity there are patches of chocolate-brown scales. On each elytron the third interstice from near the base to near the subapical tubercles, and the fifth from near the base till it joins the subapical tubercle, are almost evenly elevated instead of with interrupted elevations; the basal projections are slightly more produced than on the typical form, but not quite as strongly elevated.

ATELICUS GUTTATUS, Pasc.

Described from Tasmania and as having "Elytris maculis apicalibus." Ten specimens before me from Tasmania (Launceston and West Tamar), New South

(1) Waterhouse, Trans. Ent. Soc. Lond., 1862, p. 228.

(2) Lacordaire, Gen. des Coleop., vi., p. 408.

(3) Atlas, pl. 70, f. 2, *a*, *b*, *c*.

Wales (Galston), and South Australia (Lucindale) may belong to the species, they vary considerably in size (3-6 mm., without the rostrum); each of them has a small narrow spot of white scales on the fifth interstice on each elytron, about the summit of the apical slope; each also has a medio-basal spot on the pronotum, connected with a bisinuate basal strip of similar scales. Of these specimens one has the head and rostrum black, another has the head and part of the rostrum black, and a third has the head only black; all the others have the head and rostrum coloured as the prothorax and elytra. Two other specimens from Tasmania (Georgetown and Launceston), in addition to the subapical spots, have the suture white at the apex; the Launceston specimen has the head and rostrum black.

Atelicus fusiformis, n. sp.

Reddish, antennae somewhat paler than other parts. Closely covered with scales similar to the derm on upper surface, becoming white on under parts.

Rostrum almost parallel-sided, moderately curved, slightly longer than prothorax; with crowded, partially concealed punctures. Prothorax moderately transverse, sides gently rounded and subcontinuous with those of prothorax and elytra; with large punctures. Elytra narrow, parallel-sided to near apex, separately strongly rounded at base, apical slope long and gradual; with regular rows of large punctures. Length (excluding rostrum), 4 mm.

Western Australia: Perth (C. French, sen.). Unique.

A narrow fusiform species with the apical slope more gradual than usual. *A. miniatus,* with similar clothing, is decidedly wider, with outlines much as those of the species here identified as probably *A. guttatus*. The scales on the upper surface so closely resemble the derm that at first sight the latter appears to be glabrous, on close examination they cause it to appear finely granulated or even shagreened.

Atelicus latericollis, n. sp.

Reddish, coxae and clubs blackish. Closely covered with scales similar to the derm on upper surface, but with small white spots; under parts mostly with whitish scales.

Rostrum distinctly curved, slightly longer than prothorax; with coarse, partially concealed punctures. Prothorax strongly transverse, base strongly bisinuate and much wider than apex, sides gently incurved; with coarse and rather dense punctures. Elytra rather thin, almost parallel-sided to near apex; with regular rows of large, deep punctures; apical slope scarcely the length of prothorax. Length, 5 mm.

Tasmania: Cradle Mountain (A. M. Lea). Unique.

There is a small white spot on the fifth interstice on each elytron at the summit of the apical slope, as on the species supposed to be *A. guttatus,* but in addition there are many small white specks scattered about, especially on the sides; from that species, however, as from all others of the genus, it is distinct by the sides of the prothorax being gently incurved, instead of rounded.

Misophrice.

The genus *Misophrice* is one of the most abundantly represented in Australia, and its minute, slow-moving species may confidently be looked for wherever trees or shrubs of the genus *Casuarina* [4] occur. By its clawless tarsi and six-jointed funicle it may be readily distinguished from all other described Erirhinides. *Anarciarthrum* with the funicle five-jointed is very close to it, and quite possibly some of the species at present standing as *Misophrice* may be found to belong to

[4] I did not, however, find it in Fiji on *C. equisetifolia*, the only species I was able to examine there.

it. *Thechia* with the funicle seven-jointed has a somewhat different appearance, and the species occur on *Eucalypti.* The species of *Micraonychus* also have clawless tarsi, are to be taken on *Casuarinae,* and at first glance appear to belong to *Misophrice,* but as they have a well-defined pectoral canal, the genus was referred to the Cryptorhynchides. Two tables of the genus were given by Blackburn [5] and myself [6] each dealing with comparatively few species; with over fifty now known, and many of them variable, I am unable to prepare a satisfactory table, but the following division of the species into groups should simplify the task of identifying them:—

Group 1. Elytra tuberculate.
tuberculata, Lea.

Group 2. Elytra with numerous erect bristles.
alternata, Lea; *argentata,* Blackb.; *hispida,* Pasc.; *hobleri,* Lea; *setosa,* Lea.

Group 3. Derm of elytra entirely concealed by clothing.
cristatifrons, Lea; *orthorrhina,* Lea; *squamibunda,* Lea; *squamiventris,* Lea.

Group 4. Derm of elytra entirely black.
arida, Lea; *gloriosa,* Lea; *griffithi,* Lea; *insularis,* Lea; *parallela,* Blackb.; *soror,* Lea; *viridisquama,* Lea.

Group 5. Derm of elytra with isolated dark spots or vittae.
amplicollis, Lea; *apionoides,* Lea; *blackburni,* Lea; *carteri,* Lea; *inflata,* Lea; *rufiventris,* Lea; *spilota,* Blackb.; *vicina,* Lea; *vittata,* Lea.

Group 6. Derm of elytra at most with base and suture dark.
amplipennis, Lea; *brevisetosa,* Lea; *clathrata,* Lea; *cylindrica,* Lea; *dispar,* Blackb.; *dissentanea,* Lea; *dubia,* Lea; *evanida,* Lea; *fenestrata,* Lea; *inconstans,* Lea; *minima,* Lea; *munda,* Blackb.; *nigriceps,* Lea; *nigripes,* Lea; *nigriventris,* Lea; *oblonga,* Blackb.; *setulosa,* Blackb.; *submetallica,* Blackb.; *V-alba,* Lea.

Notes on above Groups.

amplipennis, Lea. An occasional specimen has the derm of the elytra almost black.
gloriosa, Lea. Some specimens might be regarded as belonging to Group 2.
quadraticollis, Blackb. Unknown to me, by the description it evidently belongs to Group 6.
squamiventris, Lea. On some specimens there are a few erect setae on the apical half of the elytra.
squamosa, Blackb. Described as piceo-nigra, so evidently belongs to Group 4.
variabilis, Blackb. Very variable in size and colour, specimens before me could be referred to Groups 4, 5, and 6.

MISOPHRICE OBLONGA, Blackb., var.

Two specimens from Queensland appear to belong to this species but are unusually small. One, from Bribie Island, is but 1 mm. in length, its prothorax is somewhat infuscated and its scales are without metallic gloss. The other, from Mount Tambourine, is very little longer, its pronotum is normally pale, and most of its scales are bluish.

---

(5) Blackburn, Proc. Linn. Soc. N.S. Wales, 1890, p. 354.

(6) Lea, Trans. Roy. Soc. S. Austr., 1899, p. 159.

MISOPHRICE SOROR, Lea, var.

Three specimens from Bribie Island are distinctly smaller (1 mm.) than usual.

MISOPHRICE GLORIOSA, Lea, var. G.

Four specimens from the Upper Williams River (New South Wales) appear to represent another variety of this species; on three of them the sutural clothing is denser than on the rest of the elytra, but is not quite continuous to the base, and on the rest of the elytra it is bluish. On the fourth specimen it is dense on the suture to the extreme base, but on the rest of the elytra is more or less golden; on all four of them the prothorax is non-vittate, but it has numerous black specks owing to the exposure of the derm.

Misophrice ursa, n. sp.

♂. Brownish-red, tarsi darker. Densely squamose and setose.

Rostrum slightly shorter than prothorax, moderately curved, with fine ridges alternated with rows of punctures almost to apex, but concealed on basal half. Prothorax slightly longer than the apical width and slightly shorter than the basal, sides moderately rounded; with dense and rather coarse, concealed punctures. Elytra oblong-cordate, not much wider than prothorax; with rows of large, subquadrate punctures, appearing much smaller through clothing. Legs stout. Length, 2·5-3·0 mm.

South Australia: Ooldea and Tarcoola (A. M. Lea). Western Australia: Kalgoorlie (W. du Boulay).

A fairly large, densely squamose species, with stout, erect setae, and so belonging to Group 2. The general outlines are much as on *M. squamibunda*, but the clothing is different; on an occasional specimen of that species, however, there are a few setae on the apical slope of the elytra. The clothing is so dense that (except on the apical half of the rostrum) it is only where abrasion has taken place that the derm becomes visible. On the upper surface the scales are mostly of a pale rusty-red, with more or less conspicuous paler and darker spots; on the under parts they are paler (almost white on some specimens). On the elytra the suture is pale throughout, and there are whitish spots or short vittae forming a postmedian series on the even interstices, immediately before and behind those on the second and fourth there are darker spots; the clothing on the basal third of the fifth interstice is whitish, and it is mostly whitish on the apical slope. On most parts the scales are evenly placed, but on the elytra they are so placed that two or more converge to form angles or minute arrow-heads; although dense the scales are so large that the arrangement is quite evident. On several specimens two ill-defined vittae are traceable on the pronotum. The setae are stiff, erect, and numerous, but irregularly distributed, they are absent from the white spots or vittae on the elytra, are fairly numerous at the apex of prothorax, between the eyes, and on the legs; on the elytra, viewed from behind, they appear to form six small fascicles across the middle on the even interstices, but from the sides they are seen to be scattered. Three specimens have the tip of an oedeagus protruding, but their abdomen is without a depression. The only specimen from Tarcoola is apparently a female, it differs from the others in having less of the rostrum clothed, and the apical segment of abdomen with a shallow depression.

Misophrice vittata, n. sp.

Densely clothed with rusty-brown scales with conspicuous whitish vittae, under surface with silvery-white scales; elytra with very short, depressed setae, less numerous on pronotum.

Rostrum moderately curved, about the length of prothorax; apical half glabrous and with minute punctures. Prothorax almost as long as its greatest width, sides moderately rounded. Elytra with basal half parallel-sided; with rows of large punctures, appearing much smaller through clothing. Apical segment of abdomen with a semi-circular apical depression. Length, 3 mm.

South Australia: Lucindale (B. A. Feuerheerdt, No. 723). Unique.

A conspicuously-marked species allied to *M. squamibunda.* It belongs to Group 3, as the setae on the upper surface are so short and slope at such a slight degree from the horizontal that they are inconspicuous, even from the sides. The derm is almost everywhere concealed, but where a slight amount of abrasion has taken place, it is seen to be of a dingy red, as is the apical half of the rostrum. The pale scales on the upper surface form a conspicuous median vitta on the pronotum, and an interrupted one on each side; on the elytra they clothe the median third of the suture, the basal third of the second and third interstices, the median fifth of the fifth, the median three-fifths of the seventh, the postmedian portion of the eighth, and most of the ninth and tenth; the postmedian portion of the third is also paler than the adjacent parts; the scales surrounding the eyes are also conspicuously pale. There are two feeble crests between the eyes. The type is probably a female.

Misophrice albolineata, n. sp.

Densely clothed with variegated scales, becoming uniformly pale, but scarcely white, on under parts. With numerous short, subdepressed, inconspicuous setae.

Rostrum about the length of prothorax, moderately curved; apical half shining and punctate, basal half with rows of concealed punctures. Prothorax almost as long as the greatest width, sides strongly rounded, punctures normally concealed. Elytra oblong-cordate, distinctly wider than prothorax; seriate punctures probably large, but appearing small through clothing. Length, 2·5-2·75 mm.

Queensland: Mount Tambourine, in January (A. M. Lea).

A beautiful species of Group 3, with sharply contrasted markings on the elytra; it is allied to *M. orthorrhina,* but the rostrum is decidedly longer and moderately curved; on *M. squamiventris* the rostrum is distinctly longer and thinner. On the upper surface most of the scales are of a pale-fawn colour; on the pronotum there is a conspicuous dark median vitta; on each elytron there are silvery-white vittae occupying the median half of the third, fifth, and seventh interstices (on the type interrupted on the fifth and seventh), the adjacent scales being mostly black, but with small whitish spots. The elytral setae are distinct only from the sides. The legs, rostrum, antennae, and the normally concealed base of head are more or less reddish, but elsewhere the derm is completely concealed. The two specimens obtained are probably females, as the only depression on the abdomen is a slight apical one.

Misophrice lata, n. sp.

Dark reddish-brown, rostrum and legs somewhat paler, antennae still paler. Densely clothed with pale ochreous-grey scales, somewhat variegated on upper surface, becoming uniformly pale on under parts. With numerous short, subdepressed, dark setae, distinct only from the sides.

Rostrum about the length of prothorax, moderately curved; with fine ridges alternated with rows of punctures almost to apex, but concealed on basal fourth. Prothorax distinctly transverse, base about one-fourth wider than apex, sides moderately rounded; punctures crowded but normally concealed. Elytra rather wide, oblong-cordate; seriate punctures appearing small through clothing, but probably of large size. Length, 3·25 mm.

Queensland: Dalby (Mrs. F. H. Hobler). Unique.

Belongs to Group 3, and is one of the largest of the species without erect setae; the elytral markings are somewhat as on *M. V-alba*, but the elytra themselves are decidedly wider in proportion, and the rostrum and legs are shorter. On the middle of each elytron, narrowed to the suture, there is a large subtriangular space, on which the scales are mostly whitish, but they are not very sharply contrasted with the adjacent ones, and appear more as mottlings than as distinct vittae. The middle of the pronotum has been partly abraded, but from the scales left at the base was apparently clothed with darker scales than on the adjacent parts. As the only depression on the abdomen is a slight apical one the type is probably a female.

Misophrice grisea, n. sp.

Black, rostrum and legs obscurely reddish, scape paler. Densely clothed with pale-greyish scales mixed with a few darker ones, and becoming paler on under parts.

Rostrum about one-fourth longer than the prothorax, rather thin and moderately curved; with rows of punctures almost to apex, but concealed on basal fifth. Prothorax distinctly transverse, sides moderately rounded, apex about one-fourth narrower than base. Elytra oblong-cordate; with rows of large, partially concealed punctures.

South Australia: Mount Lofty Range (N. B. Tindale). Unique.

A rather wide species of Group 4, larger and with different clothing from all other members of that group. The clothing of the elytra consists of true scales, without an admixture of setae, even as viewed from the sides; they are mostly in double (in places treble) rows on the interstices, but are sparser on the first, second, fourth, and sixth than on the others; on the sides of both the upper and under surfaces they have a faint bluish or greenish gloss. On the elytra most of the odd interstices are wider than the even ones. As the only depression on the abdomen is a small one at the apex the type is probably a female.

Misophrice subvariabilis, n. sp.

♂. Black; part of abdomen, of legs, and of antennae obscurely reddish. Moderately clothed with thin whitish scales or depressed setae, becoming green on under parts, but absent from rostrum (except close to base), and from parts of the two basal segments of abdomen.

Rostrum about the length of prothorax, thin, evenly curved and shining; with a row of distinct punctures on each side of base, becoming feeble in front. Prothorax small, moderately transverse, sides strongly rounded in front; with crowded punctures only partially concealed. Elytra large, slightly dilated to beyond the middle; with regular rows of large punctures. Two basal segments of abdomen with a wide shallow median depression, with distinct punctures, and traversed by many fine striae. Length, 2-2·75 mm.

♀. Differs in having the rostrum distinctly longer than the prothorax, thinner and with less distinct punctures; abdomen rather strongly convex, with the depression on the two basal segments greatly reduced in size and with a small apical one, more evenly (although not densely) clothed, and with the punctures and striae less evident.

South Australia: Ooldea, Barton, Tarcoola (A. M. Lea).

Var. A. Elytra reddish except for the base suture and a spot on each side which are blackish, or at least infuscated, legs more reddish than on typical form and portion of rostrum more or less distinctly reddish.

Specimens of this variety are mostly but not entirely females.

Var. B. As variety A, except that the elytral spots are changed to vittae, and are continuous almost to base and apex.

Specimens of this variety vary considerably in intensity of colour, and there are many connecting ones between the typical dark form and variety A. About half of them are males.

Var. C. As variety A, except that the elytra are without isolated dark spots.

One male and two females are before me; but some specimens of variety A have the spots so faint that they might almost be referred to this variety.

Of the 187 specimens of this species before me about half have the elytra entirely dark, or so dark that the spots or vittae are scarcely indicated. Comparing them with long series of *M. variabilis* the following differences are apparent: Average size smaller, average colour darker, prothorax always black, rostrum slightly shorter and thinner (sex for sex), spotted specimens more numerous than vittate ones. The clothing of the upper surface appears to be always white, but on the under parts is sometimes bluish or greenish. Most of the specimens with black elytra are males, most of those with partly red elytra are females, but the sexes cannot be distinguished by the colour alone; although each sex has a depression on the two basal segments of abdomen, that of the male is considerably larger (but not deeper) and conspicuously glabrous. Typical specimens may be distinguished from *M. arida, parallela,* and *soror,* by their larger size and partly red legs, and from the others of Group 4 by the clothing more like depressed setae than true scales. Those of varieties A and B from *M. carteri* and *rufiventris* by the positions of the spots or vittae, and from the others of Group 5 by the entirely black prothorax.

MISOPHRICE DISPAR, Blackb.

Numerous specimens beaten from a species of *Casuarina* growing beside a river at Paipa (near Noumea) agree perfectly with specimens of this species from Queensland, New South Wales, Victoria, and South Australia.

Misophrice obliquialba, n. sp.

♂. Black; elytra (except base, sides, and suture), abdomen, legs (except tarsi), and antennae (except club), reddish. Rather sparsely clothed with whitish scales, but with a conspicuous white oblique vitta on each side of mesosternum, and another on each side of apex of prosternum.

Rostrum evenly curved, about the length of prothorax; with rows of punctures and glabrous except at extreme base. Prothorax slightly shorter than the greatest width, sides strongly rounded in front; with numerous sharply defined punctures. Elytra distinctly wider than prothorax, slightly dilated to beyond the middle; with regular rows of large punctures. Length, 1·75 mm.

New Caledonia: Paipa, near Noumea (A. M. Lea).

A small species of Group 6. The oblique white lines are very conspicuous; somewhat similar lines are faintly indicated on the Australian *M. nigripes,* but on that species the legs are entirely dark. The species is about the size of *M. dispar,* but more parts are black.

Two specimens that are probably females of the species differ in being slightly larger, in having most of the scales green (variation in colour of scales is a common feature in Australian species of the genus), the tarsi infuscated instead of black, and the rostrum longer and more curved. Another specimen probably also belongs to the species, but its prothorax is somewhat reddish, less of the elytra dark, and rostrum no darker than the femora and tibiae. Each of the three specimens has the oblique white lines of the typical form, but they are less sharply contrasted, owing to the density and colour of the adjacent scales.

Misophrice sordida, n. sp.

Black; elytra, except base and suture, rostrum and abdomen, obscurely reddish, legs and antennae, except club, somewhat paler. Sparsely clothed with whitish scales.

Rostrum about the length of prothorax, evenly curved; with a distinct row of punctures on each side, and glabrous except near base. Prothorax moderately transverse, sides strongly rounded in front; with dense, sharply defined punctures. Elytra oblong-cordate, parallel-sided to beyond the middle; with regular rows of large punctures, becoming smaller posteriorly. Two basal segments of abdomen with a shallow median depression. Length, 1·75-2 mm.

New Caledonia: Paipa (A. M. Lea).

A dingy species of Group 6, about the size of the preceding one, but elytra wider at base and less dilated posteriorly, tarsi no darker than tibiae, and mesosternum without white lines. The type is probably a male, a second specimen is probably a female, it has the rostrum slightly longer, more curved and black, and the abdomen more convex.

Misophrice wardi, n. sp.

Pale castaneo-flavous; head, rostrum (the ends darker than the middle), scutellum, metasternum, club and tarsi more or less deeply infuscated. Densely clothed with whitish scales, in parts with a greenish or coppery gloss.

Rostrum thin, moderately curved, and about one-fourth longer than prothorax. Prothorax slightly transverse, sides rounded and dilated from apex to base, which is conspicuously trilobed; punctures normally concealed. Elytra parallel-sided to beyond the middle, the width of base of prothorax, base deeply trisinuate, with regular rows of fairly large punctures. Two basal segments of abdomen with a shallow median depression. Length, 2 mm.

Central Australia, on "desert oak" *Casuarina decaisneana* (C. Barrett). Unique.

A pale fusiform species with the base of the prothorax conspicuously trilobed and consequently the base of the elytra as deeply trisinuate, characters at once distinctive from all other species of the genus. The green scales are most noticeable on the metasternum, but they probably vary in extent; the pronotum has a somewhat speckled appearance; on the elytra the scales are usually in two rows on each interstice. The type appears to be a male.

At Mr. Barrett's request I have pleasure in dedicating this species to Dr. L. Keith Ward, Government Geologist of South Australia, and who, with him, accompanied the recent "Reso" expedition to Central Australia, and helped to collect some of the insects.

Misophrice barretti, n. sp.

Blackish, some parts obscurely diluted with red, antennae (club excepted) and tarsi paler. Densely clothed with bright-green scales, but a wide median space on the under surface glabrous.

Rostrum thin, rather strongly curved, and much longer than prothorax. Prothorax distinctly transverse, sides moderately rounded; punctures normally concealed. Elytra slightly wider than prothorax at base, sides feebly dilated to beyond the middle; with rows of large partially concealed punctures. Length, 1·50-1·75 mm.

Central Australia, on "desert oak" *Acacia decaisneana* (C. Barrett).

A beautiful species in general appearance strikingly close to *Anarciarthrum viride*, but with the funicle six-jointed. *M. viridisquama* has somewhat similar outlines, but the elytral scales are thinner and not placed in two even rows on each interstice, as on this species. On *M. insularis* the elytra are parallel-sided and the

scales are in single rows. Two specimens were obtained, apparently sexes, as the abdomen of the smaller specimen is less convex than that of the larger one, and its apical segment has a small depression, the elytra are less dilated posteriorly and the rostrum is slightly shorter; it is also obscurely reddish near the tip.

THECHIA CINERASCENS, Lea.

Several specimens of this species are now before me from New South Wales (Newport and Forest Reefs) and Victoria (Warburton, from moss). On the specimen from Forest Reefs the markings are more conspicuous than on the type. On its pronotum there is a narrow pale median line, followed on each side by a broad slaty-brown one, a narrow pale one, then a narrower dark one (invisible from above); on each elytron the suture, sides, and a median vitta are pale, but the pale and dark parts are less sharply limited than on the pronotum. The specimen from Warburton is smaller than the type, and the scales on its upper surface are even less contrasted. The type is a male; the female differs in having the rostrum longer and thinner, clothed only near base, and the two basal segments of abdomen evenly convex, instead of with a shallow median depression.

In the species the scrobes are turned underneath the rostrum and meet at its base, as a result of which, when the antennae are set out, the base of the under surface appears conspicuously notched from the sides; a character that may eventually be considered as of generic importance.

Thechia mollis, n. sp.

♂. Black. Densely clothed with muddy-brown and whitish scales, becoming uniformly white on under parts.

Rostrum moderately thin, gently curved, the length of prothorax; punctures concealed by clothing. Prothorax slightly wider than long, sides gently rounded, but more strongly at apex; punctures crowded but normally concealed. Elytra parallel-sided to beyond the middle and then oblique to apex, which is notched; with rows of large punctures, appearing as feeble striae through clothing. Two basal segments of abdomen large, the first slightly longer than second and as long as three apical ones combined. Length, 2·75-3·0 mm.

Western Australia: Swan River (A. M. Lea).

Structurally close to *T. cinerascens*, but slightly narrower, the rostrum somewhat shorter and stouter, clothed to the apex, and not notched at the base of its lower surface. On the type the clothing on the head and rostrum is almost uniformly dingy-brown, on the pronotum there is a pale median line and the sides are widely pale; on the elytra there are some pale irregular spots on the shoulders, at the basal third, and on and about the suture at the apical third. On a second specimen the clothing of the head and rostrum is much as on the type, but on each elytron the white spots are so numerous that they form a mass from the shoulder to the apical third, where it is deflected to the suture, with a few scattered singly; on its under surface the scales have a faint bluish gloss. As on both specimens the rostrum is clothed throughout, and there is a shallow depression common to the metasternum and two basal segments of abdomen, they are evidently males.

Cratoscelocis, n. g.

Head small. Eyes rather small, elliptic-ovate, lateral, finely faceted. Rostrum rather long and thin but somewhat flattened, almost straight; scrobes deep and oblique, beginning in middle of sides and terminating at lower edge of eyes. Antennae rather short, scape as long as funicle, which is composed of six joints, club briefly ovate. Prothorax transverse, without ocular lobes. Scutellum small. Elytra parallel-sided to near apex, base trisinuate. Basal segment

of abdomen large, second and fifth subequal, third and fourth small. Legs short and stout, front coxae almost touching, middle ones moderately separated, the hind ones widely so; femora edentate; tibiae unusually short and stout, tarsi apparently three-jointed. Irregularly squamose.

Apparently belonging to the Erirhinides, and near *Thechia*, but the funicle is six-jointed; *Misophrice* also with it six-jointed has much thinner legs. The tibiae are stout, and from some directions their widest part appears to be close to the base, the front ones are feebly bisinuate on the lower surface, and each is terminated by an obtuse hook, but their sculpture is obscured by the dense clothing; the tarsi appear to be three-jointed, but the third joint is very feebly notched, and under the microscope the remnant of a claw joint becomes visible, it differs slightly in colour from the adjacent part, and does not extend to the apical fringe, claws apparently are not present; from directly behind the front coxae are seen to be slightly separated, but from most points of view they appear to be in contact.

Cratoscelocis foveicollis, n. sp.

Reddish-castaneous. Irregularly clothed.

Rostrum slightly longer than prothorax, punctures concealed on basal half and very fine elsewhere. First joint of funicle stouter than the others, and about as long as the second and third combined, second slightly longer than third, fourth to sixth moderately transverse. Prothorax with extreme base almost twice as wide as the median length, obliquely narrowed to apex, near apex with a continuous narrow impression, traversed by large deep punctures or small foveae (partly obscured by clothing), elsewhere with minute punctures. Elytra not much wider than base of prothorax; with regular rows of large deep punctures, usually slightly wider than the interstices. Length, 1·5-1·75 mm.

New South Wales: Sydney (H. J. Carter), National Park (A. M. Lea).

The head and part of rostrum, all margins and a median line on pronotum, suture, shoulders, and tips of elytra are clothed with greyish-white scales, the rest of the upper surface being glabrous; on the under surface and legs the clothing is denser, with a muddy or paste-like appearance.

A specimen from the Blue Mountains (Dr. E. W. Ferguson) is larger (2·5 mm.), somewhat darker, and with a slightly wider rostrum, but apparently belongs to the same species.

Aolles.

The tarsi of most species of this genus at first appear to be three-jointed, with the third joint large but slightly notched, on wetting them, however, the notch becomes more distinct and usually a small claw joint, but its claw or claws are usually not very distinct amongst the marginal fringe. On examining the tarsi from below the third joint appears to have a fine median suture, at the extremity of which a claw appears as a somewhat finer seta than the adjoining ones. On several species the claw joints with a single claw are distinct. I think it probable that several of the species referred by Chevrolat to his sixth division of *Haplonyx*, really belong to *Aolles*. On *A. tibialis* two claws to each tarsus may be seen, and it is probable that on other species two claws are so close together that they appear single. It is probable, therefore, that the only valid distinction between *Aolles* and *Haplonyx* is in the antennae. The Australian genera of the subfamily may be thus distinguished:—

Funicle seven-jointed, claw joint distinct.
  Each claw joint with a single claw .. .. *Haplonyx*
  Each with two claws apparently conjoined at base .. .. *Sigastus*
Funicle six-jointed, claw joint inconspicuous or wanting.
  Rostrum long, thin, and conspicuously curved .. .. .. *Zeopus*
  Rostrum wider and straight or almost so .. .. *Aolles*

Aolles ornatipennis, Blackb., formerly Haplonyx.

The claw joint of this species is thin and inconspicuous and the funicle is six-jointed; it is therefore an *Aolles.* It is also, I think, the species named by Chevrolat as *Haplonyx nigrirostris* (an earlier name). A specimen from Arno Bay (South Australia) probably belongs to the species, but has the median fascia interrupted at the suture, and the submedian tooth of the front tibiae more acute and slightly nearer the base than on some cotypes.

Aolles tibialis, Lea, formerly Haplonyx.

On examining the tarsi of this species from below each claw joint is seen to be thin and terminated by two small unequal claws; from above the joint and its claws are indistinct, the claws appearing like some of the setae fringing the third joint. The funicle is certainly six-jointed, so the species should stand in *Aolles,* unless a new genus should be considered necessary for it.

Aolles puncticollis, Lea.

Additional specimens from Bowen, Cairns, and Thursday and Horn Islands are smaller (3-3·25 mm.) than the type, and some of them have the dark humeral patch extended narrowly to the scutellum; on the base of the third interstice on each elytron, of all of them, there is a short vitta of white scales.

Aolles minimus, Lea, var.

A specimen from Mount Victoria (New South Wales) apparently belongs to this species, but differs from the type and five other specimens in having the head, rostrum, and parts of the legs blackish.

Aolles uniformis, Lea.

The type of this species has pale and almost uniformly coloured scales densely plating the derm; but there are now before me numerous specimens from South Australia (Mount Lofty Ranges, Callington, Moonta, and Kangaroo Island), that appear to belong to the species, but differ in having two transverse series of irregular brownish spots or mottlings on the elytra, the sub-basal series sometimes appearing as a rather wide fascia; on other parts of the elytra, and on the pronotum, there are also more or less distinct mottlings. The seriate punctures on the elytra are in very weak striae (as on *A. longirostris),* but the rostrum is decidedly shorter in both sexes than on that species. The white vittae on each side of the scutellum of that species are sometimes faintly indicated, but are usually absent. Two specimens, from Melrose and Lucindale, have almost uniformly pale rusty-brown scales on the upper surface, with feeble pale spots on the elytra, and a few dark scales scattered singly. One from Quorn has the whole of the upper surface mottled. Another, from Murray Bridge, has the head, rostrum, scutellum, abdomen, and parts of the legs black; there are numerous spots of dark scales on its elytra, and the compaction of some of these into the fasciae is rather slight.

Aolles longirostris, Lea.

The types of this species are females. The male differs in having the rostrum slightly wider, about one-third shorter, and with coarser punctures on the basal half. The clothing about the basal half of the elytra is usually variegated with blackish spots, with a short white vitta on each side of the scutellum. The species occurs in Victoria and South Australia, as well as in Western Australia.

AOLLES ORBICULATUS, Lea.

On typical specimens of this species the elytra are clothed with sooty scales, sharply outlined by a white marginal fringe; but on many specimens there are numerous irregularly distributed whitish scales about the apex, and these become more numerous, till occasionally the scales on the apical half are more than two-thirds white, and there are numerous other white scales towards the base; the white ones, however, never seem to form a median fascia. The rostrum and legs vary from reddish to deep black.

Aolles marmoratus, n. sp.

♂. Reddish-brown; head, scutellum, suture, and most of under surface black or blackish. Moderately clothed with slightly variegated scales, becoming paler on under parts, and very dense on sides of mesosternum and metasternum.

Rostrum broad, straight, and about the length of prothorax; with thin ridges, and coarse, confluent, partially concealed punctures on basal two-thirds, then with smaller but still crowded naked punctures. Prothorax strongly transverse, sides almost evenly oblique to apex, which is about half the width of base. Elytra cordate, outlines subcontinuous with those of prothorax; with rows of large punctures, mostly partly obscured by clothing. Length, 3-4 mm.

♀. Differs in being somewhat larger, rostrum thinner, slightly longer, with shorter ridges and finer punctures (although coarse), which are naked to the base.

South Australia: Lucindale (B. A. Feuerheerdt and F. Secker), Mount Lofty Ranges (S. H. Curnow). Victoria: Portland (H. W. Davey).

The scales on the upper surface are mostly stramineous or pale ochreous, mixed with paler ones where they are densest, as on the sides of the prothorax (which are feebly vittate) and middle of elytra (where there is a feeble fascia); there are also some rounded snowy scales in the striae. Owing to the varying density of the clothing the surface to the naked eye appears somewhat mottled. On several specimens the second and fourth interstices on each elytron, beyond the median fascia, have a vittate appearance, owing to their scales being denser and paler than on the adjacent ones. On one of the many Lucindale specimens the rostrum is entirely dark. The granules on the prothorax and elytra are dense and small, and normally obscured or concealed by the clothing. It is allied to or perhaps a variety of *A. rubiginosus*, but the average size is consistently a little larger, the median fascia is composed of white or whitish scales, and the white scales in the striae are sparser and less conspicuous.

On this and all the following species the femora are stout and strongly dentate and, unlike most species of *Haplonyx*, are without a supplementary tooth in the notch, the front tibiae are short and distinctly bisinuate on the lower surface, or really trisinuate, as there is a short notch between the subapical tooth and the terminal hook, so that the tibiae appear tridentate; the middle and hind tibiae have an apical fringe of black setae, as on most species of *Haplonyx*. Unless otherwise noted the claw joint is inconspicuous, except that at right angles its single claw appears as a median seta not projecting beyond the apical fringe of the claw joint. In all of them the funicle is certainly six-jointed.

Aolles fasciatus, n. sp.

Reddish-brown, some parts black. Densely clothed with variegated scales, the darker ones forming four large spots or two interrupted fasciae on elytra.

Rostrum slightly longer than prothorax, almost straight; with five thin ridges alternated with coarse punctures on basal half, in front with crowded, partially confluent punctures. Prothorax strongly transverse, sides strongly rounded, base more than twice the width of apex. Elytra short, outlines continuous with those

of prothorax; with rows of large punctures, mostly obscured by clothing. Length, 3-3·5 mm.

South Australia: Leigh Creek (Rev. T. Blackburn), Lucindale (F. Secker), Tintinara (J. G. O. Tepper), Murray Bridge (A. M. Lea). Victoria: Sea Lake (J. C. Goudie). New South Wales (Blackburn's collection): Lake Victoria (Capt. S. A. White).

An ovate or briefly elliptic species, somewhat shorter than the preceding one, elytral outlines evenly continuous with those of prothorax, the base more conspicuously trisinuate and the darker fasciae due to clothing. From *A. rubiginosus* it is also distinct by the elytral clothing, including the absence of snowy scales from the striae. The clothing is denser than on *A. ornatipennis.* The head and under surface are black on most specimens, but occasionally the abdomen is obscurely reddish; about half of them have the rostrum black, on the others it is more or less reddish. The clothing on the upper surface is mostly rusty-yellow or pale ochreous, often with sooty scales sprinkled on the disc of the pronotum, and white or stramineous ones (sometimes condensed into feeble vittae) on its sides. On the elytra there are large patches of sooty scales, which, near the base, form a rather wide fascia, interrupted near the suture, then there is a pale median fascia beyond which the sooty scales form a very irregular fascia or two large irregular spots. On the under surface and legs the clothing is whitish, becoming slightly ochreous on the sides, and very dense on the mesosternum and metasternum. Some specimens have the rostrum slightly longer and thinner than on others, with the punctures slightly less coarse and the ridges slightly shorter, they are probably females, but the sexual differences are not very pronounced. The prothoracic punctures are normally almost concealed, and also the elytral granules, but the latter are fairly distinct on the dark parts. The specimen from Lake Victoria has only the head black; the scales on its under surface and pronotum are pale stramineous, except that a few sooty ones are on the front of the latter; on the elytra there is a rather broad dark sub-basal band, but beyond it the median fascia and postmedian spots are feeble and irregular.

Aolles pictus, n. sp.

Black; legs, antennae, and parts of upper surface reddish. Densely clothed with rusty-red scales, with conspicuous blackish patches on upper surface, on under surface and legs mostly whitish.

Rostrum slightly longer than prothorax, feebly curved; basal half with fine ridges and series of large punctures, apical half with dense, partially confluent punctures. Prothorax at base more than twice as wide as long; densely granulate punctate. Elytra closely applied to prothorax; with rows of large punctures, interstices with numerous granules, in parts concealed. Length, 3·75 mm.

South Australia: Ooldea (A. M. Lea). Unique.

A beautiful species; the elytra with red basal median and apical fasciae clothed with reddish or ochreous scales, the adjacent parts and the suture black and clothed with blackish scales, the apical fascia, however, is joined to a vitta on each side of the suture, which extends almost to the median fascia, on the right elytron appearing like the letter L. On the pronotum much of the discal clothing is dark, but there is a narrow median line of reddish scales, and the sides are densely clothed with them. It is entirely without the snowy scales in the striae characteristic of *A. rubiginosus.* The general outlines are as in many species of the genus.

Aolles rufirostris, n. sp.

♂. Reddish, under surface usually darker, head black. Moderately clothed with whitish or stramineous scales, with sooty ones on the elytra, forming a wide fascia from near base to near middle, and a large spot on each side of apical half.

Rostrum rather wide, about the length of prothorax; basal two-thirds with five thin ridges, alternated with rows of punctures, apical third with crowded punctures. Prothorax and elytra with outlines, punctures, and granules much as on two preceding species. Length, 3-3·5 mm.

♀. Differs in having the rostrum slightly longer, thinner, and with shorter ridges.

Queensland: Dalby (Mrs. F. H. Hobler).

The elytral clothing is slightly variable, the paler scales are fairly dense on the base, margin the sides, and form a median fascia, connected rather widely along the suture with the apex, the darker scales cover more than half of the surface. To a certain extent the elytral markings are somewhat as on the preceding species, but on that species the sutural scales are dark, without interruption by the fasciae. The rostrum has conspicuous ridges and is red to the base, in sharp contrast with the black head. There are some denticules between the median projection and the subapical tooth of the front tibiae.

Aolles maculipennis, n. sp.

♂. Reddish, head black. Moderately clothed with stramineous scales, on the elytra irregularly mixed with dark ones, middle of pronotum with many dark scales; under surface with whitish scales, becoming stramineous, denser and larger on sides of mesosternum and metasternum.

Rostrum slightly longer than prothorax; with five thin ridges, alternated with rows of coarse punctures on basal two-thirds; on apical third with crowded, partially confluent punctures. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Length, 3·5-4·0 mm.

♀. Differs in having the rostrum slightly longer, thinner, and with shorter ridges.

South Australia: Parachilna (E. L. Savage), Leigh Creek, Quorn (Blackburn's collection).

Possibly a variety of *A. orbiculatus*, but consistently larger, and much of the elytra clothed with pale scales, although, except that they are uniformly dense at the base, they are very irregularly distributed, and do not form fasciae; on the apical slope they are quite uniform on several of the interstices on most of the specimens; on several the darker scales are in the majority. On an occasional specimen, usually a male, the rostrum and parts of the under surface are blackish.

Aolles basalis, n. sp.

♂. Black or blackish, some parts reddish. Densely clothed with variegated scales.

Rostrum about the length of prothorax; with fine ridges alternated with partially concealed punctures on basal two-thirds, apical third with smaller but more sharply defined ones. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Length, 3-3·5 mm.

♀. Differs in having the rostrum slightly longer and thinner, with less defined ridges and smaller punctures.

South Australia: Ooldea (A. M. Lea).

A beautiful species, in appearance approaching some specimens of *A. orbiculatus*, but with snowy-white scales individually larger and more rounded (much as those in the striae of *A. rubiginosus*), they are dense at the base of pronotum and rusty-red on the rest of its surface, the two colours of varying extent and irregularly conjoined, with a few sooty scales scattered about; on the base of elytra (but not on the scutellum, which appears as a black spot), on the apical third, and irregularly on the sides the scales are white, elsewhere, except for a

few scattered white ones, they are sooty; on the under surface and legs they are white, becoming stramineous on the sides of sterna. Of the five specimens taken, two have the rostrum black, two have it red, and the other has it dark reddish-brown; the antennae in all are red, except that the apical half of the club is infuscated.

Aolles basipennis, n. sp.

Dark reddish-brown, antennae somewhat paler. Densely clothed with stramineous, sooty, and white scales.

Rostrum rather wide and straight, slightly longer than prothorax; with dense punctures, sharply defined in front, larger and more confluent posteriorly; with feeble, irregular basal ridges. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Length, 4 mm.

Queensland: Bowen (Aug. Simson). Unique.

The rostral ridges are shorter and less distinct than usual. On *A. sobrius* (about the same size and with somewhat similar elytral clothing, except at the base), the rostral ridges are longer and more conspicuous than usual. In general the species is close to *A. orbiculatus*, except that the marginal fringe of pale scales is absent from the sides and apex of elytra. On the head and pronotum the scales are stramineous, with a few dark ones scattered about; the elytra are clothed with sooty scales, except for a narrow basal strip of stramineous ones, present also on the scutellum, and a few white ones in the striae; on the under surface and legs the scales are white, becoming denser, longer, and stramineous on the sides of the mesosternum and metasternum. The type is probably a female.

Aolles vertebralis, n. sp.

Reddish. Densely clothed with rusty-yellow and sooty scales, becoming whitish and stramineous on under parts.

Rostrum wide, quite straight, and very little longer than prothorax; basal half with feeble ridges, alternated with coarse punctures, apical half with smaller and more sharply defined punctures. Length, 2·5 mm.

South Australia: Gawler (J. Faust). Unique.

On the pronotum the scales are mostly rusty on the sides, with a large median patch on which they are mostly sooty; on the elytra they are sooty except for a narrow sutural vitta of rusty ones. The general outlines are much as on most species of the genus, but the series of punctures on the elytra are, if present, entirely concealed on the type, except near the base; the elytra also appear to have no granules.

Aolles quinquecarinatus, n. sp.

♂. Reddish. Moderately clothed with white and stramineous scales on upper surface, becoming denser and uniformly white on under parts.

Rostrum wide, straight, and the length of prothorax; with five strong ridges, alternated with rows of punctures to apical third, on which the punctures are smaller but more sharply defined. Prothorax at base twice as wide as the median length; densely granulate-punctate. Elytra with outlines continuous with those of prothorax; with rows of large, deep punctures, becoming smaller posteriorly, the interstices multigranulate. Length, 3·5 mm.

Queensland: Bluff (A. M. Lea). Unique.

In general appearance, largely owing to the coarse elytral punctures, like some of the smaller non-fasciculate species of *Haplonyx*, but the funicle is distinctly six-jointed; each claw appears as a thin seta in the marginal fringe of the third tarsal joint, but the claw joints themselves are very inconspicuous. The rostral carinae are unusually well defined. On the upper surface most of the scales are thin and stramineous, or slightly rusty; on the sides of the prothorax they are

mostly white, and form irregular vittae, there is also a thin white line down its middle, continued on to the scutellum.

Aolles albus, n. sp.

Pale reddish-castaneous, head somewhat darker. Densely clothed with white scales.

Rostrum almost straight, the length of prothorax; basal three-fifths with fine ridges, alternated with rows of coarse punctures, apical two-fifths with crowded, sharply defined punctures. Prothorax and elytra with normal outlines, punctures, and granules. Length, 3 mm.

South Australia: Murray Bridge (A. M. Lea). Unique.

The scales are dense on most parts and uniformly white, except that there are a few inconspicuous dark ones on parts of the elytra.

Aolles ferrugineus, n. sp.

Black, most of antennae reddish. Densely clothed with rusty-red scales, on upper surface variegated with whitish and darker ones, on parts of under surface whitish.

Rostrum wide, short and straight, no longer than prothorax; with fine ridges, alternated with rows of coarse, partially concealed punctures on basal two-thirds, elsewhere with smaller crowded punctures. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Length, 3·5 mm.

King Island (A. M. Lea). Unique.

In some respects close to *A. variegatus,* but larger, clothing denser, more rusty, and on the sides of the prothorax vittate. From *A. ornatipennis,* which is probably a synonym of *A. nigrirostris,* it differs in the entirely black derm, in its clothing, and its shorter and wider rostrum. Each thin claw joint with its claw does not project beyond the lobes of the third tarsal joint, but is sufficiently distinct when the tarsi are viewed at right angles. Most of the clothing on the upper surface is of a rusty-red colour, variegated with whitish subvittate spots on the sides of the prothorax, and scattered white scales, mostly in the striae, on the elytra, there are but few sooty scales, although they appear to be more numerous than they really are owing to exposures of the derm. On the abdomen, except at the sides of the basal segments, and on the middle of the metasternum, the scales are whitish; on the rest of the under surface, and on the legs, they are not much paler than the rusty ones on the upper surface.

Aolles rostralis, n. sp.

Dark reddish-brown, antennae somewhat paler. Densely clothed with large, soft, stramineous, or pale rusty-yellow scales, becoming paler on under parts; elytra with a broad, dark, sub-basal fascia, and a large spot on each side near apex.

Rostrum slightly curved, comparatively thin, slightly longer than prothorax and scutellum on male, still longer on female; with crowded punctures throughout, and with feeble ridges on basal half. Length, 3·5-3·75 mm.

South Australia: Leigh Creek (Rev. T. Blackburn).

A densely squamose species, with a dark sub-basal fascia on the elytra, and a dark postmedian spot on each side, the latter sharply defined on two specimens, broken up into spots with a faint tendency to become fasciate on two others; the markings, therefore, are somewhat suggestive of those of *A. fasciatus,* but the clothing is much denser, and the rostrum is decidedly longer and thinner. The rostrum is unusually long and thin for the genus, and is also somewhat curved, although not as in *Zeopus.* The general outlines and the punctures and the granules are apparently as on most species of the genus, but the derm is almost everywhere concealed by the clothing.

Aolles multimaculatus, n. sp.

Reddish-brown; antennae, except part of club, paler. Rather densely clothed with whitish or stramineous and sooty scales, irregularly mingled on upper surface, becoming almost uniformly white on under parts.

Rostrum slightly longer than prothorax, gently curved; with crowded punctures, and on basal half feeble ridges. General outlines as on most species of the genus. Length, 2·5-2·75 mm.

Victoria: Sea Lake (J. C. Goudie).

In general appearance like some of the varieties of *A. orbiculatus*, but the rostrum is noticeably curved. On the prothorax the paler scales are in the majority on the sides, but not in the middle; on the elytra the dark scales are most numerous, the white ones forming small irregularly distributed spots, with the tendency to form a feeble postmedian fascia, and a short vitta on each side of the scutellum. The elytral punctures are apparently of moderate size, but they are considerably obscured by the clothing, although the rows are more distinct than on *A. vertebralis*. The notch of the third tarsal joint is sufficiently distinct, but the claw joint and its claw are not evident, at least the claw does not appear as a median seta in the apical fringe.

Aolles intermedius, n. sp.

♂. Black, antennae reddish. Clothed with white, stramineous, and sooty scales on upper surface, snowy-white on under parts.

Rostrum slightly longer than prothorax, slightly wider than each eye, moderately curved; with fine ridges alternated with rows of punctures behind antennae, with comparatively small but sharply defined punctures in front. Prothorax more than twice as wide as long, base not quite twice the width of apex; with crowded and mostly concealed punctures. Elytra with outlines continuous with those of prothorax, base trisinuate; with rows of fairly large partially concealed punctures; interstices finely granulate. Length, 2·75-3 mm.

♀. Differs in having the rostrum about one-third longer, thinner, more shining, with smaller punctures and shorter ridges, and antennae inserted in middle of sides of rostrum, instead of two-fifths from apex.

South Australia: Port Lincoln (Rev. T. Blackburn and A. M. Lea).

In general appearance like many specimens of *A. orbiculatus* and *A. basipennis*, but rostrum longer, thinner, and moderately curved. At first glance resembling some varieties of *Zeopus storeoides*, but the rostrum of the female is not much more than half the length of that of the male of that species, and considerably less than half of that of its female; it is, however, decidedly more curved than on any previously described species of *Aolles*. On the pronotum the stramineous scales cover most of the sides, the sooty ones most of the middle; on the elytra the stramineous ones cover a narrow part of the base (including the scutellum) and the sides, elsewhere, except for some scattered white scales, the clothing is sooty. The third tarsal joint appears to be rather widely notched, but this is due to the absence of fringing setae from its middle; the claw joint is concealed, but its claw appears as a finer seta than any of those in the apical fringe. The female from Port Lincoln has parts of the derm obscurely reddish, but probably the derm varies as in most species of the subfamily. A second female from Monarto is slightly larger, with pale scales of upper surface almost white, and in sharper contrast with the black ones, its rostrum is slightly longer, although much shorter than on the male of *Z. storeoides*.

Aolles intermixtus, n. sp.

Reddish-brown. Densely clothed with variegated scales, becoming almost uniformly white on under parts.

Rostrum wide, straight, and slightly longer than prothorax; with fine ridges, alternated with rows of punctures on basal two-thirds, elsewhere with crowded punctures. Prothorax more than twice as wide as long, sides oblique to apex, which is about half the width of base; with crowded, but normally concealed punctures. Elytra with outlines continuous with those of prothorax; with rows of large, partially concealed punctures, interstices with fine, normally concealed granules. Claw joints thin and distinct. Length, 4 mm.

North-Western Australia: Fortescue River (W. D. Dodd). Unique.

A fairly large species, with white, rusty-yellow, and sooty scales on the elytra, irregularly distributed, but to the naked eye appearing in feeble zones or fasciae; there is a fairly wide sooty zone near the base, and a smaller one beyond the middle, and the scutellum appears as a round dark spot; on the pronotum there are only whitish and rusty-yellow scales, also irregularly mingled. The base of the elytra, except for the incurvature at the scutellum, is almost straight, instead of distinctly trisinuate.

On this and on the three following species, the thin claw joint with a single claw projects well beyond the lobes of the third joint of each tarsus, and the general appearance is as of non-fasciculate species of *Haplonyx*, but as the funicle is certainly six-jointed (all have been examined under the microscope) they have been referred to *Aolles*.

Aolles latirostris, n. sp.

Reddish. Densely clothed with variegated scales on upper surface, becoming uniformly white on under parts.

Rostrum wide, straight, and the length of prothorax, sides gently incurved to middle; with fine ridges, alternated with rows of squamiferous punctures to insertion of antennae, in front with dense, naked punctures. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Claw joints distinct. Length, 2·75 mm.

Queensland: Longreach (A. M. Lea). Unique.

In general appearance like the preceding species on a reduced scale, and with the claw joint equally prominent; the clothing is of much the same colours, but is opaque, and less intermingled, with the scales on the scutellum white. On the pronotum the scales are mostly dark stramineous, with a few white spots on the sides, and white ones scattered singly elsewhere; on the elytra most of them are of a rusty-yellow, with an irregular dark fascia at the basal third, and short, white vittae forming feeble fasciae at the base, beyond the middle, and near the apex.

Aolles parvus, n. sp.

Reddish. Densely clothed with variegated scales, becoming white on under parts.

Rostrum wide, straight, and about the length of prothorax; with fine ridges, alternated with rows of squamiferous punctures on basal three-fifths, elsewhere with crowded, naked punctures. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Claw joints distinct. Length, 2·25 mm.

Northern Territory: Roper River (N. B. Tindale). Unique.

Smaller than the preceding species, and with about half of the elytral scales black. On the upper surface the scales are rusty-yellow, white and sooty, on the pronotum they are mostly rusty, with white vittae on the sides, and two small white submedian spots, on the base there are three small feeble dark spots. On the elytra there is a wide, irregular, black fascia, extending from near the base to near the middle; beyond the middle the black, white, and rusty scales are irregularly mingled, about the base they are rusty, with a few white ones. Directly from behind rows of snowy scales may be seen in the striae.

Aolles inconspicuus, n. sp.

Black, some parts obscurely diluted with red, antennae reddish. Densely clothed with somewhat rusty and sooty scales, becoming white on under parts.

Rostrum wide, straight, and the length of prothorax; basal three-fifths with fine ridges, alternated with rows of squamiferous punctures, elsewhere with crowded naked punctures. Prothorax and elytra with outlines, punctures, and granules as on most species of the genus. Claw joints distinct. Length, 2·25 mm.

Queensland: Brisbane (H. J. Carter). Unique.

The size of the preceding species, but head and rostrum black, the elytral clothing of two colours only, and most of the discal scales of the pronotum sooty. The clothing is as on many specimens of *A. orbiculatus*, but each claw joint projects well beyond the lobes of the third. On the pronotum the paler scales form two oblique vittae on each side, with a few scattered singly on the disc; on the elytra they rather narrowly clothe the base (including the scutellum), the margins on the basal half, and form small irregularly distributed spots elsewhere.

Aonychus picatus, n. sp.

♂. Black. Densely clothed with black and white scales on upper surface, white on lower surface and legs.

Rostrum rather thin, moderately curved, the length of prothorax; with some strong punctures about base. Prothorax moderately transverse, sides strongly rounded, base strongly bisinuate and about twice the width of apex; punctures normally concealed. Elytra cordate, distinctly wider than prothorax; with series of fairly large, concealed punctures. Two basal segments of abdomen with a shallow median depression, clothed with setae instead of scales. Length, 4·5-5·5 mm.

♀. Differs in having the rostrum slightly longer, with sparser punctures about base, and two basal segments of abdomen strongly and evenly convex.

Western Australia: Cunderdin, in September and October.

A multimaculate species with deep black and snowy-white scales. On the head they are mostly white, with a round black patch in front; on the pronotum the white scales form a median line on the basal half, and two large spots on each side, but the spots are connected with the white mass below; the scutellum appears as a white spot; on the elytra the white spots are numerous, and so placed as to appear irregularly fasciate, and to enclose round or subquadrate black spots. On *A. luctuosus* the black scales of the elytra are more conspicuous about the suture than elsewhere, and the white ones are somewhat longitudinally arranged; on the present species they could be regarded as forming very irregular transverse or zigzag fasciae. There are other specimens in the Western Australian Museum, No. 8278.

Aonychus barbatus, n. sp.

♂. Blackish-brown, parts of antennae paler. Densely clothed with sooty-brown and white scales on upper surface, entirely white on under surface and legs. Rostrum with an apical fringe on each side of about eight, rather long, yellowish bristles.

Rostrum thin, strongly curved, sides slightly incurved between antennae and apex. Prothorax and elytra with outlines and sculpture as on the preceding species, except that the series of punctures on the elytra are less concealed by the clothing. Length, 6 mm.

Northern Territory: Bathurst Island, in October (G. F. Hill). Unique.

Readily distinguished from all other species of the genus by the bearded rostrum, which, however, is probably confined to the male. The dark scales clothe the front of the head, median part of pronotum, except for remnants of a

white cross, and most of the elytra, on the latter the white ones form short vittae, and interrupted fasciae, so placed that there appear to be two large, quadrangular sutural spots on the basal half, and a small square spot at the basal third on the fifth interstice; on the apical slope the white spots are small and numerous. There is a slight flattening in the middle of the two basal segments of abdomen, but they are without the usual setose depression of the males of the genus.

Aonychus lituratus, n. sp.

♂. Black, parts of antennae obscurely reddish. Densely clothed with black and white scales on upper surface, white on under surface and legs.

Rostrum rather long and thin, rather strongly curved; with a short ridge near base, on each side of which the punctures are dense and rather coarse, elsewhere with fine punctures. Prothorax slightly transverse, base strongly bisinuate and about twice the width of apex; with crowded, concealed punctures. Elytra cordate; with regular rows of large, partially concealed punctures. Two basal segments of abdomen with a shallow median depression, clothed with scales instead of setae. Length, 6 mm.

Queensland: Claudie River (J. A. Kershaw). Type (unique), in National Museum.

In general appearance fairly close to the preceding species, but the dark scales blacker, the white ones differently disposed, and the rostrum not bearded. The black scales form a round spot on the front of the head, clothe the median part of pronotum, and most of the elytra; on the pronotum the white ones on the sides are advanced in a zigzag manner on the disc, there are also two minute median white spots and a medio-basal one; on the elytra the white spots are small and irregularly distributed, except that some are united to form an irregular T or short broad Y, on and near the suture about the summit of the apical slope.

Micraonychus.

In the original diagnosis of this genus it was noted that the funicle should probably be considered as seven-jointed rather than six-jointed. I have recently re-examined some of the types and many fresh specimens (including *M. maculatus, sordidus, decipiens,* and *nigrirostris),* as well as several new species, and now consider that the funicle should be regarded as really six-jointed, as it certainly appears to be under a fairly high power; the eighth joint of the antennae is usually closely applied to the club, and apparently forms part of it, as on *Misophrice,* although it is usually without the fine sensitised pubescence of the club, its derm generally has the appearance of the funicle, rather than of the club. In *M. maculatus,* however, it is slightly narrower than the sixth joint of the funicle, and distinctly narrower than the following joint, and, although it appears to belong to the club, its clothing is different.

Micraonychus nigrirostris, Lea.

Three specimens evidently belonging to this species, from Queensland (National Park and Mount Tambourine), are smaller than usual, on one of them many of the scales are of a brilliant green, on another many are of a coppery-red, on the third many are coppery, and others green. The species is distinct by its black rostrum.

Micraonychus illotus, n. sp.

Dull brownish-red; head and metasternum darker; club, most of funicle, and tarsi black. Moderately clothed with muddy-grey scales, becoming paler on under surface.

Rostrum slightly longer than prothorax, thin, curved, shining, and with rows of distinct punctures on basal half, smaller scattered ones elsewhere. Funicle distinctly six-jointed. Prothorax almost as long as wide, base strongly bisinuate and almost twice the width of apex; with crowded, partially concealed punctures. Elytra oblong-cordate, sides gently dilated to near middle; with rows of large, partially obscured punctures, alternate interstices feebly elevated. Pectoral canal deep, ending abruptly in middle of metasternum. Length, 3·5 mm.

South Australia: Lucindale (B. A. Feuerheerdt).

A large, dingy species; at first glance the type looks like a large, dirty specimen of *M. cinerasceus,* but its pectoral canal is shorter; on that species it extends to the abdomen.

Micraonychus interruptus, n. sp.

Dull reddish-brown, rostrum and scape paler, rest of antennae and tarsi black. Densely clothed with silvery-white scales, in parts obscured by muddy-grey ones.

Rostrum thin, the length of prothorax, moderately curved; with rows of punctures on basal half, sparse and small elsewhere. Funicle six-jointed. Prothorax almost as long as wide; punctures crowded but normally concealed. Elytra not much wider than prothorax, parallel-sided to beyond middle; with regular rows of large punctures, appearing much smaller through clothing. Pectoral canal deep, ending abruptly before middle of metasternum. Length, 2·5-2·75 mm.

Tasmania: Launceston (F. M. Littler and Aug. Simson).

Most of the derm is normally concealed. On specimens in good condition the white scales form a median line on the pronotum and are dense on the sides; on the elytra they are dense, leaving parts of the suture, fifth and seventh interstices bare (and consequently appearing vittate), a bare antemedian part of the seventh is directed obliquely backwards, to join in with a bare postmedian patch on the fifth. Rubbed or dirty specimens are difficult to distinguish from rubbed or dirty ones of *M. decipiens.*

Micraonychus coelosternus, n. sp.

Black; elytra, parts of under surface, femora, tibiae, apical half of rostrum (the base obscure), and scape more or less obscurely reddish. Moderately clothed with whitish scales, with a slight bluish tinge.

Rostrum thin, curved, shining, the length of prothorax, and with rows of fine punctures. Funicle six-jointed. Prothorax about as long as wide, sides rounded and somewhat narrowed to apex; with crowded punctures. Elytra oblong-cordate, but rather narrow; with rows of large, partially obscured punctures. Pectoral canal deep and fairly wide to middle of metasternum, thence connected with abdomen by a narrow groove. Two basal segments of abdomen with a large, shallow depression. Length, 2 mm.

New South Wales: Upper Williams River (A. M. Lea). Unique.

Evidently allied to *M. rufimanus,* but without the large soft scales characteristic of that species, and with a longer pectoral canal, which is narrowly connected with the abdomen. The partly red rostrum distinguishes from *M. nigrirostris.* The clothing is not very dense, and the individual scales are seldom distinct, except on the under surface, where some of them have a slight metallic gloss. The abdominal depression is probably a masculine feature.

GEOCHUS, Broun, Man. N. Z'land Col., iv., p. 931.

Two species of this genus were first referred to *Geophilus,* but finding that name had already been used, Broun proposed the name *Geochus.*(7) The species

(7) Broun, N. Z'land Jour. Sci., i., 1882, p. 128.

are remarkable for their flattened, broad forms, widely separated front coxae, and three-jointed tarsi. The genus was originally placed in the Diabathrariides, but in the systematic index to the Manual at the end of the Cylindrorhinides. It really appears to be an aberrant one of the Cryptorhynchides. Twenty-six species are known from New Zealand, and one can now be added from Lord Howe Island, taken from fallen leaves, as were most of the others.

Geochus howensis, n. sp.

Black; antennae, except club, reddish. In parts sparsely and obscurely clothed.

Head small, with dense punctures. Eyes small, lateral, with coarse facets. Rostrum short, dilated to near apex, with three longitudinal ridges. Antennae inserted near apex of rostrum, scape dilated at apex; funicle seven-jointed, first joint subglobular. Prothorax transverse, flat, base evenly curved and twice the width of apex; with crowded, deep punctures of moderate size, and with a feeble median ridge. Elytra closely applied to prothorax, sides dilated to basal third and then oblique to apex; with rows of large, rough punctures, wider than interstices, these somewhat irregular. Femora rather stout, edentate; tibiae with a small terminal hook, tarsi short, apparently three-jointed. Length, 1·5-2·0 mm.

Lord Howe Island, eleven specimens from fallen leaves (A. M. Lea and wife).

Differs from *G. inaequalis* and *G. marginatus*, New Zealand species, in the elytra. The legs, tip of abdomen, and sometimes parts of the elytra, are obscurely diluted with red. Seen directly from above more than half of the elytra appears as a large triangle, owing to the sides being obliquely cut off from the basal third, the interstices are in parts uneven, although hardly tuberculate, the irregularity being most noticeable at the basal third. The distance between the front coxae is more than the width of a coxa. One of the specimens has the elytra more strongly sculptured than the others, the second interstice on each elytron is flattened except for a sudden elevation at the basal third, the third is elevated to the basal third, then suddenly interrupted, and then with two elevations, the fifth is conspicuously elevated from the base to beyond the middle, and the sixth is also elevated in part.

Achelocis, n. g.

Head small, round. Eyes small, lateral, with coarse facets. Rostrum rather long, thin, and moderately curved; scrobes deep and oblique in front, then shallower on under surface almost to eyes. Antennae rather thin; scape almost as long as funicle and club combined; funicle seven-jointed; club moderately long. Prothorax transverse, base strongly and evenly rounded, sides strongly rounded. Scutellum minute. Elytra slightly wider than long, sides strongly rounded, surface uneven. Mesosternum semicircularly emarginate at apex, without a median groove. Metasternum very short, episterna not apparent. Abdomen rather small, first segment as long as second and third combined, third and fourth combined the length of second and slightly longer than fifth. Legs moderately long; front coxae almost touching, middle ones moderately, the hind ones widely separated; femora rather stout, neither grooved nor dentate; tibiae slightly bisinuate on lower surface, apical hook small; tarsi three-jointed. Coarsely sculptured and sparsely clothed.

The type is a singular insect, for which at present I am unable to suggest a subfamily, although it is probably near the Cryptorhynchides. In its general appearance it has somewhat the look of the rough, granulate species of *Tentegia*, of that subfamily, and its general outlines, rostrum, and abdomen are much as those of *Cycloporopterus*, but the total absence of a pectoral canal should forbid its being referred to the Cryptorhynchides. The upper surface of the third tarsal

joint appears to be almost evenly rounded, and under the microscope I cannot see even the rudiment of a claw joint; the under surface is densely padded and feebly notched in the middle.

Achelocis rudis, n. sp.

Black; antennae, tibial hooks, tarsi, and parts of elytra reddish. Sparsely clothed with pale setae.

Head with coarse punctures and a small median fovea. Rostrum slightly longer than prothorax, somewhat thickened, and with coarse, crowded punctures about base, elsewhere smaller and more or less lineate in arrangement. Funicle with two basal joints moderately long and subequal, their combined length slightly less than that of the five following ones. Prothorax with numerous fine, transverse, irregular ridges, in front of which are coarse punctures, but with coarse punctures only on sides. Elytra strongly and almost evenly rounded; with shallow striae, containing large, irregularly spaced punctures, the interstices with irregular series of small, round, shining granules. Sterna and two basal segments of abdomen with coarse, irregular punctures. Length, 3·5 mm.

Queensland: Cairns (Dr. E. W. Ferguson). Unique.

A briefly ovate, strongly convex, rough-looking species. In certain lights there appear to be three obscurely reddish irregular fasciae on the elytra, one at the base, one near and one slightly beyond the middle, and irregular patches elsewhere; the elytral granules are in single series, but all more or less irregularly interrupted.

ABORIGINAL STONE STRUCTURES IN SOUTH AUSTRALIA.

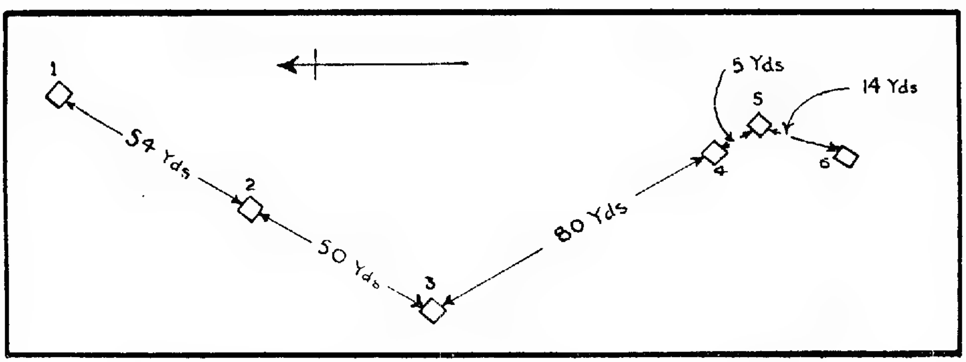
By C. P. Mountford.

[Read August 11, 1927.]

Plates IX. and X.

Aboriginal monuments of stone are practically unknown in South Australia, and the examples about to be described have not been previously recorded. Wood Jones [1] shows photographs of stone cairns on the Gungra claypan which are apparently about 2 feet high and in the centre of a complex arrangement of stones laid in place by the aborigines.

The examples now described are, however, quite distinct and represent a new type of stone structure. They were first noticed by the author, when, in company with his father, Mr. C. Mountford, and Mr. H. L. Sheard, he was searching for native rock carvings near the Weroonee Range, about 173 miles, 11° east of north of Adelaide, and, approximately, 13 miles due north of Paratoo, on the Broken Hill railway line. While examining an example of aboriginal intaglios on the property of Mr. G. Fuller, at Wabricoola, Mr. Fuller mentioned that his father had shown him, many years previously, some stone structures, and told him that they had been used by the aborigines during rain-making ceremonies. He kindly accompanied us to the foot-hills of the Weroonee Range, and although unsuccessful himself in locating them, roughly indicated their position to us. After some trouble we found six stone structures, situated on a low foot-hill to the north of the Weroonee Ranges, at a point about 5½ miles south-west of Wabricoola Station. Three of the examples had been erected on the top of the hill; the remaining three were grouped close together on the western slope. The accompanying diagram shows the relative position of each structure in the group:—



Plan of Aboriginal Stone Structures at Weroonee Range.

Nos. 1, 2, and 3 were in a straight line, oriented approximately north-east. The first was 54 yards, and the third 50 yards, from No. 2. No. 4 was 80 yards south-east from No. 3, and No. 5 was 5 yards further on in the same direction. No. 6 lay 14 yards south-westward from No. 5.

(1) Wood Jones, Prof. F., Journ. Anthrop. Inst. Gt. Brit., vol. lv., 1925, p. 123.

The bases of all the structures were square, with the corners directed towards the four points of the compass. Four of the stone piles were partly dismantled, No. 3 almost totally so, while Nos. 2 and 4 were complete. The example No. 4 was the most perfect example of the group, and, at the instance of Prof. F. Wood Jones, and with the help of Messrs. C. Mountford and P. Stapleton, was dismantled and presented to the South Australian Museum (pl. ix.).

The stone pile was constructed in a remarkable manner; and while dismantling it we had an excellent opportunity of noticing several peculiarities. In the first place, a floor had been laid down with flat slate stones and two narrow stone slabs, about 3 feet 6 inches long, 6 inches wide, and 2 inches to 3 inches thick, were placed upon them parallel to each other and, approximately, 3 feet apart. Two similar stones were arranged on the top of, and at right angles to these, about the same distance apart, allowing the ends to overlap a little. The construction was continued in this manner, each pair of stones being at right angles to the previous ones and of decreasing length for 28 layers, forming a pile 3 feet 8 inches high, which was 3 feet square at the base and 1 foot 6 inches square at the top, with a hollow down the middle. The rule shown in pl. ix. is 6 inches long.

More care was taken in building this structure than appeared at first glance, the stones having been chosen of decreasing length to make a building of the shape shown in pl. ix. It was also noticed that where the slates did not bed properly, small packing pieces had been inserted to prevent rocking. No mortar or any form of fastening was used, the weight of the stones keeping the construction together. A large flat stone 15 inches by 24 inches was noticed on the ground adjacent to this example. We dug the ground upon which the pile had been erected, but found nothing; in fact the earth appeared to have been previously undisturbed. The rocks in this locality weather out into long narrow slates, which are particularly suitable for building the special form of structure; in fact, they probably determined its form. The collecting of the stones over an extensive area to provide sufficient material for this and the other examples must have entailed considerable time and labour.

No. 1 structure was partly demolished, only ten layers of stone standing, the remainder lying around in confusion. The base was 12 inches square, and the height was 16 inches. The method of construction was somewhat different from that of the previous example, and although the stones were disarranged, there were strong indications that a smaller structure had been built on the north-eastern side and joined to the main one by stones laid parallel to each other. A large flat stone 40 inches long was noticed lying adjacent to this example.

After having photographed this arrangement, the stones lying about were utilised to reconstruct the pile, and it was found that the remaining loose ones made it 3 feet high and comprised 30 layers.

Structure No. 2 was built in a different manner from the other examples, being solid, similar to the base of a European tower or cairn of a similar shape. It was rectangular in form, 3 feet 6 inches by 4 feet and 18 inches high, and was composed of stones more or less rectangular in shape. The long slates utilised in the other examples were not used in this case, and no loose stones were noticed lying around it.

The structure called No. 3 was almost totally dismantled, only a few stones remaining to indicate the former existence of a stone erection similar to, but somewhat smaller than No. 4.

No. 5 was similar to No. 1, except that there were no indications of an additional arrangement on the side. It was partly broken down, only twelve rows

being in place, the remaining stones lying beside it in disorder. It was about 12 inches square at the base and the undisturbed portion was 20 inches high (pl. x., fig. 4). As in Nos. 1 and 4, a large flat stone was lying adjacent to the structure. This measured 24 inches by 30 inches.

The last example, No. 6, was very similar to No. 5, being 12 inches square at the base and about 20 inches high, with fourteen rows left standing, the remainder lying about as in the other examples. A flat stone similar to those near the other three was noticed (pl. x., fig. 3).

Mr. P. Stapleton has since described to the author a similar structure, one and a half miles north-west of Beltana and 70 yards from the railway line. Another was within sight to the west on the side of a hill. He also kindly supplied a photograph (pl. x., fig. 1) which shows that although the long narrow slates were not available, a similar manner of building was used; that is, two stones were placed parallel and the next two laid on top at right angles to them. Mr. Stapleton also mentioned that he saw quite a number of similar examples in the Flinders Ranges between Wilpena and Copley, and on enquiring from local residents he learned that they extended from Wilpena in the south to Wooltana in the north.

Mr. H. M. Hale, of the South Australian Museum, presented the author with a photograph of a similar structure (pl. x., fig. 2) taken when visiting the country at the Owienagin Pound. The construction of this was very similar to that of the Weroonee examples, and was also situated on a hillside.

Motives for Building the Structures.

That these arrangements are the work of aborigines cannot easily be denied in view of Mr. G. Fuller's information, received from his father, that the natives had used them during rain-making ceremonies, and in connection with these ceremonies had sprinkled animal blood on the stones. It may be of interest to note that Spencer and Gillen [2] record customs of sprinkling human blood over stones during the Intichiuma ceremony of the Kangaroo and Hakea flower totems.

Mr. E. Buttfield (whose father was a former Protector of Aborigines), and who had himself spent his boyhood among the natives of the Flinders Ranges, told the author that, when a young man, he had seen stone structures similar to those shown in the photographs. He had asked the natives regarding them, and had been told that they had been made by "old man blackfellow long time ago." When questioned regarding their use, the natives professed ignorance. They denied the idea that white men had made them.

The Surveyor-General was personally interviewed and shown photographs of the Weroonee structures, and he gave his assurance that his surveyors did not build cairns of this type. The occurrence of similar structures over such a wide area in the Flinders Ranges seems to indicate the existence of a former aboriginal custom of building stone piles possibly for ceremonial purposes. Enquiries among the few remaining aborigines may give information regarding their use and name, for in view of the information received it seems likely that they may have been used during rain-making ceremonies.

The following points are noteworthy:—As previously mentioned, structures Nos. 1, 4, 5, and 6 each had a large flat stone nearby, and it seems as if these had been placed in position for some definite purpose. Examination showed that although structures Nos. 1, 5, and 6 were partly dismantled, the stones had not

[2] Spencer, Sir Baldwin, and Gillen, F., "Native Tribes of Central Australia," 1899, pp 184-201.

been removed, and there were sufficient numbers lying around to enable us to reconstruct the buildings to the height of the others. No. 3, however, was almost totally demolished, very few of the stones remaining, and it would appear that the material taken from it had been utilised to construct some other example.

Another striking feature noticed was that all the structures were built with the corners pointing to the four points of the compass. The fact that every building was similarly placed would indicate that the builders had some definite object in view, which had influenced them in their orientation of the piles.

The author wishes to acknowledge the great help received from Mr. C. Mountford, sen., Mr. H. L. Sheard, Mr. G. Fuller, and Mr. P. Stapleton, in finding these remarkable remains of aboriginal craft.

DESCRIPTION OF PLATES IX. AND X.

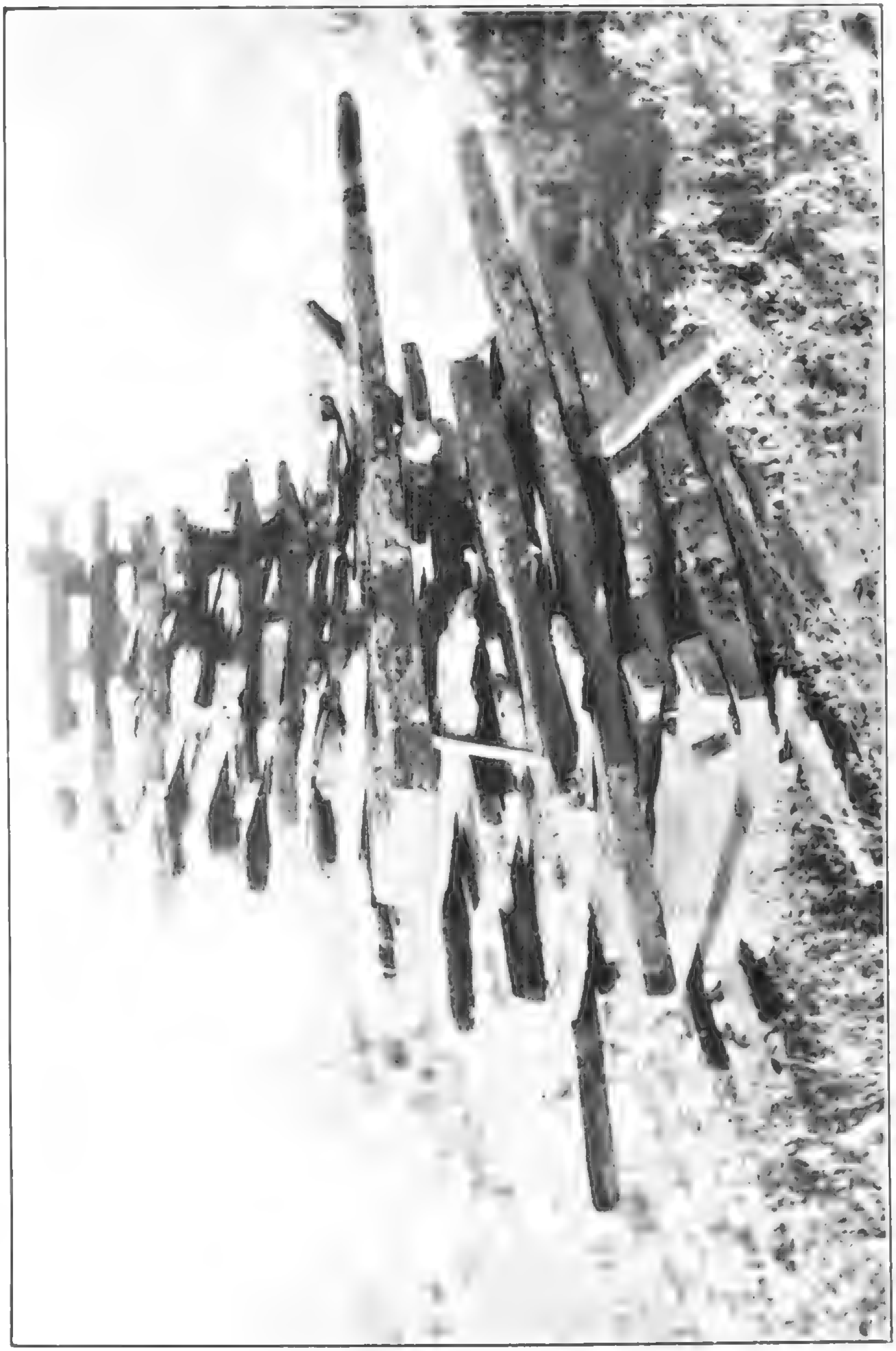
PLATE IX.

Aboriginal Stone Structure, No. 4, Weroonee Ranges.

PLATE X.

Fig. 1. Aboriginal Stone Structure, Beltana.
Fig. 2. Aboriginal Stone Structure, Owienagin
Fig. 3. Aboriginal Stone Structure, No. 6.
Fig. 4. Aboriginal Stone Structure, No. 5.

[NOTE.—Since the reading of the above paper certain statements have been made which raises some doubt as to the rock-structures described in the paper having been constructed by aborigines, or at least by aborigines uninfluenced from association with the white races. It is possible, as suggested by some, that the structures were erected as sub-"trigs" by the early surveyors, but being auxiliaries only, were not marked on the official charts. Other origins have also been suggested. The object of the present note is to prevent a possible misinterpretation of these objects and to suspend judgment until more definite evidences can be obtained as to their origin and intention.—C. P. M.]



Gillingham & Co. Limited, Printers, Adelaide

Fig. 1

Fig. 2

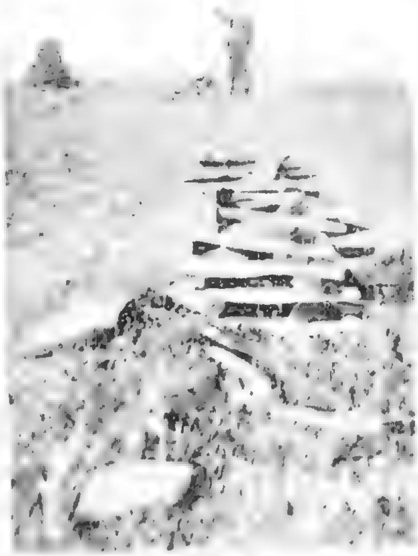


Fig. 3

Fig. 4

Gillingham & Co. Limited, Printers, Adelaide

AN UNUSUAL DISPOSAL OF AN ABORIGINAL CHILD'S REMAINS FROM THE LOWER MURRAY, SOUTH AUSTRALIA.

By Harold L. Sheard, C. P. Mountford, and Cecil J. Hackett.

[Read August 11, 1927.]

Plates XI. and XII.

This paper records the discovery of an aboriginal child's remains hidden in a cleft in the cliffs of the River Murray, near Fromm's Landing. As far as we are aware, a similar occurrence has not been recorded. Fromm's Landing is situated on the western side of the Murray, about half-way between Swan Reach and Mannum, on Section 302, Hundred of Ridley.

Travelling up the river, precipitous cliffs, about 100 feet high, abut on the stream on the western side. The main channel of the stream leaves the western cliffs, just after the landing is reached, and continues in a north-easterly direction. The cliffs recede and a large billabong, or backwater, is thus formed. This slowly rises, forming extensive mud flats, which terminate in a bank of *dêbris* at the cliffs.

Erosion has hollowed out several extensive shelters at the base of the cliffs, and these have been the habitations of aborigines for very long periods. The shelters of this locality have been previously described.(1) It was when these shelters and the cliffs were being examined for traces of aboriginal rock carvings that the remains were discovered.

In one place, about 2 chains above the large shelter, (i.) a huge mass of the cliff had become detached. This had moved sufficiently to form a fissure, about 3 feet wide, extending the whole height of the cliffs. This cleft was filled with boulders (evidently disconnected from the mass when the fissure was formed), creating a series of irregular ledges (see pl. xi., fig. 1). When this place was examined a small white object was observed resting on one of the boulders. Closer examination revealed that a child's remains had been hidden or interred on this ledge of rock, which was about 12 feet above the present bank. This bank has been considerably augmented in recent times by drift sands pouring over the cliffs (the result of agriculture in this semi-arid district). Possibly when the remains were first deposited the position was more inaccessible than when found by us.

Many places in this cleft and about the cliffs had afforded shelter to opossums *(Trichosurus vulpeculus)*, the peculiar excreta from which mixed with sandy *dêbris* weathered from the rocks had formed a pavement 2 to 3 inches in thickness on the corpse of the child, firmly cementing it to the rock on which it had been placed. By chipping away the edges of the excreta it was possible to lift away the whole mass. This, on being reversed, revealed the manner of disposal of the remains.

A net bag constructed from vegetable fibre (see Appendix), woven into a two-ply twist with an 8 cm. mesh (see text fig. 1 and pl. xii., fig. 1), had been partially filled with long grasses; on these the body had been placed in a crouched position, resting on the left side, and the whole covered with a further layer of loose grasses and the hide of a wallaby. The bag was drawn up and tied at the feet,

(1) Sheard, Harold L., Trans. Roy. Soc. S. Austr., 1927, pp. 137-140.

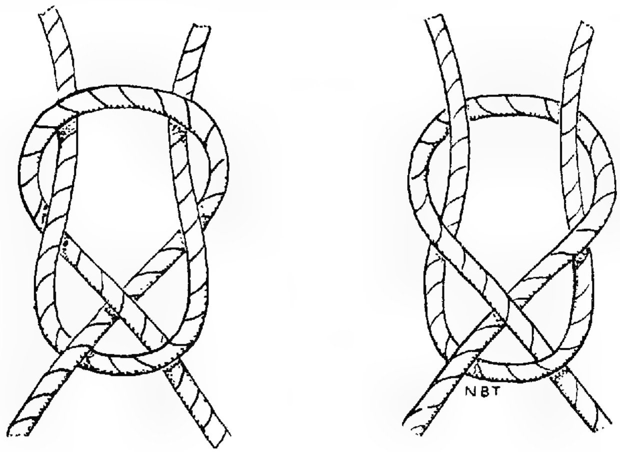
further covered with grass, and deposited in the cliff completely beyond casual observation.

The wallaby skin wrapping the body had been prepared in the well-known manner, with hammered lines forming a regular diamond pattern over its surface. At one time it had evidently formed a shallow oval container (30 x 45 cm.), since it still has attached to it a thick, coarsely twisted rush-fibre handle which is lashed on at each end by passing it through transverse slits in the skin (3 cm. in length). When the body was packed up the handle was swung under the container away from the child, and now lies partly concealed in the grass packing.

The excreta of the opossums had practically hermetically sealed the remains and overhanging rocks had sheltered them from the weather. The fibre bag and grasses, while fragile, are almost complete, and it may be observed that nothing that would indicate contact with civilization was present. In another fissure, some 10 yards away, the desiccated remains of an opossum were found preserved in a similar manner beneath a layer of dung.

The exhibit has been presented by H. L. Sheard and C. P. Mountford to the South Australian Museum, and at their request Mr. C. J. Hackett kindly consented to add the following anatomical notes.

We are indebted to Mr. N. B. Tindale for assistance in the preparation of this paper.



Fg. 1.

NOTES BY C. J. HACKETT.

The specimen as at present exhibited in the Adelaide Museum is not in the position in which it was originally found, but lies with its lower surface uppermost. In this position I will briefly describe it (pl. xii., fig. 2).

The body is lying on its right side in a state of advanced desiccation, with the spine slightly flexed in the dorsi lumbar regions and extended in the cervical region so that the occiput is looking somewhat downwards. The left side of the thorax, part of the left side of the pelvis, and the left foot are missing, and the left lower limb is not *in situ*. The left upper limb is extended and is lying along the anterior part of the spinal column. The lower limbs are apparently flexed at the hips and knees. Most of the soft parts are missing, except some skin over parts of the extremities, right flank, and part of the skull. The hands are practically intact, and are flexed and ulnar-deviated on the forearms; the right foot is less complete. There is a dried, reticulated, structureless mass, lying anterior to the spine; being, perhaps, the remnants of the contents of the thorax and

abdomen. The whole is lying on the dried, leathery material, mentioned above, and is surrounded by grass, with occasional gum leaves, except along the dorsal aspect. A net covers the grass and is drawn together at the feet, but is missing along the dorsal aspect of the body.

The Skull.—With the exception of the symphysis menti not any of the visible sutures are closed. X-ray photographs indicate that perhaps the metopic suture is closed. The sutures between the premaxillae and maxillae are open. The sagittal suture is discrete, no membrane being present, except at the anterior fontanelle, which is roughly ·75 cm. in diameter. The posterior fontanelle is closed. On following the sagittal suture posteriorly it is found to deviate to the right some 3 cm. above the lambda, and here the left parietal bone is thinned out and slightly overlaps the right. At this, the postero-median border of the left parietal is an oval depression 3 x 4 cm., its longest dimension being lateral. Its boundary is more defined on the left, where it is 2 mm. below the surface of the surrounding bone; to the right, it shelves away deflecting and squamosing the sagittal suture and also involving the right parietal for about 1 cm. The right border of the depression, on the right parietal, in its upper part, is marked by an oval crater ·75 x ·5 x ·2 cm. The surface of the bone, at the left edge, is finely pitted, but elsewhere the surface of the depression is smooth and shiny with a suspicion of striae radiating to the right. By transillumination, the bone in the depression is seen to be thinner than elsewhere. The bone around is apparently normal and not thickened.

Teeth.—In the upper jaw the full first dentition has erupted, but some are missing. The first permanent molars are seen in the alveolus, as are the permanent incisors. A similar condition is present in the lower jaw.

All the epiphyses of the long bones, vertebrae, and pelvis are separate. X-rays show no bony abnormality at the epiphyseal lines.

Conclusion.—It would be justifiable to conclude from the above that the remains are those of a child approximately two years of age. The bones are too immature to give them a sex. The period which has elapsed since its death would be difficult to assess on account of the unusual condition of its interment. Taking into consideration the good condition of the net work and grass, it may not have been so very long; but one must not neglect the possibility that the trappings in which it was found do not date from the death of the child.

There is no clue as to the cause of death. One more point remains; that is, the curious depressed area in the parietal bones. From its appearance one would exclude any inflammatory lesion; one then thinks of a fracture, and, if a fracture, it must have occurred before the membranous part of the bone had ossified; that is, within the first twelve months of life.

Skiagraphs, kindly taken at the Adelaide Hospital, support the view that the condition is a fracture (see pl. xi., figs. 2 and 3). Whether it was some accident or a deliberately inflicted injury is impossible to say, but one thing is clear, that is, it was not the direct cause of death.

In closing, I wish to thank Messrs. H. L. Sheard and C. P. Mountford for the opportunity to make these notes.

Mr. N. B. Tindale supplies the following note concerning remains of another child from the Murray cliffs:—

"We recently found the remains of an aboriginal child, of some 10 to 12 years of age, in a small cave or rockhole at Wongulla (Section B, Hundred of Forster). This cavity is situated at a height of 10 feet from the base of the cliff, 100 yards downstream from the main native shelter on the eastern bank of the river. All the bones, except those of the feet, were burnt and broken. The lower jaw with some of its teeth was present, but no other parts of the skull

were recovered. Bat-dung from a ledge above the remains had covered and preserved in part some soft grass and an open-meshed fibre bag; evidently the wrappings and container in which the bones had been stowed away. The meshes of the net were approximately 3 inches across, and the same type of knot had been used in its construction as in the bag containing the desiccated child recorded above. Two broken pieces of trimmed stick were found with the bones.

"The evidence points to the fact that in this case the body had been burned. and the remains (including the feet, which had partly escaped the flames) had been packed in grass, placed in a net-bag, and deposited in the rock-cleft."

Appendix.

The following extracts from literature are here added as bearing on the subject:—

Meyer,(2) discussing the manufacture of nets, writes:—"The string of which they are made is composed of the fibres of a kind of flag. It is prepared by roasting the leaves and afterwards chewing them; the leaf is then divided longitudinally into four, two of these are twisted by being rolled upon the thigh, and are then twisted together by being rolled the contrary way; other lengths are added until as much line is made as is required. In the operation of netting the twine is wound round a short stick which answers the purpose of a needle, and the meshes are formed and the knot tied by passing the string over and between the fingers."

Angas,(3) in his account of his early-day experiences along the Murray, near Wellington, writes:—"We met . . . a mother, wandering in search of roots, with her digging stick in her hand. . . . She carried a heavy load at her back. Night and day she bore her burden, . . . though it was a loathsome and decaying corpse. . . . . It was the dead body of her son, a child of 10 years; she had carried it for three weeks in her bundle as a tribute of her affection."

Meyer (2) further records:—"Children stillborn, or that have been put to death immediately after birth, are burned. If a child dies a natural death, it is carefully packed up, and the mother or grandmother carries it about with her for several months or a year, after which it is exposed upon a tree until the bones are completely cleaned, after which they are buried."

Wyatt (4) states:—"The women more especially are so strongly attached to relatives that they hesitate for a long time to part with a dead body; and mothers are often known to carry about their persons dead infants, carefully wrapped up, for many months, while offensive decomposition must undoubtedly be going on."

DESCRIPTION OF PLATES XI. and XII.

Plate XI.

Fig. 1. Fissure in cliffs where remains were found (×).

Figs. 2 and 3. Radiographs of skull.

Plate XII.

Fig. 1. Under surface of specimen (as found) showing grass and net work.

Fig. 2. Specimen with covering thrown back showing remains (as exhibited in S.A. Museum).

---

(2) Meyer, H. E. A., "The Native Tribes of South Australia," 1879, pp. 193, 198.

(3) Angas, G. F., "Savage Life . . . in Australia," vi., 1847, p. 75.

(4) Wyatt, William, "The Native Tribes of South Australia," 1879, p. 165.

Fig. 1.

Fig. 2.

Fig. 3.

Gillingham & Co. Limited, Printers, Adelaide.

Fig. 1

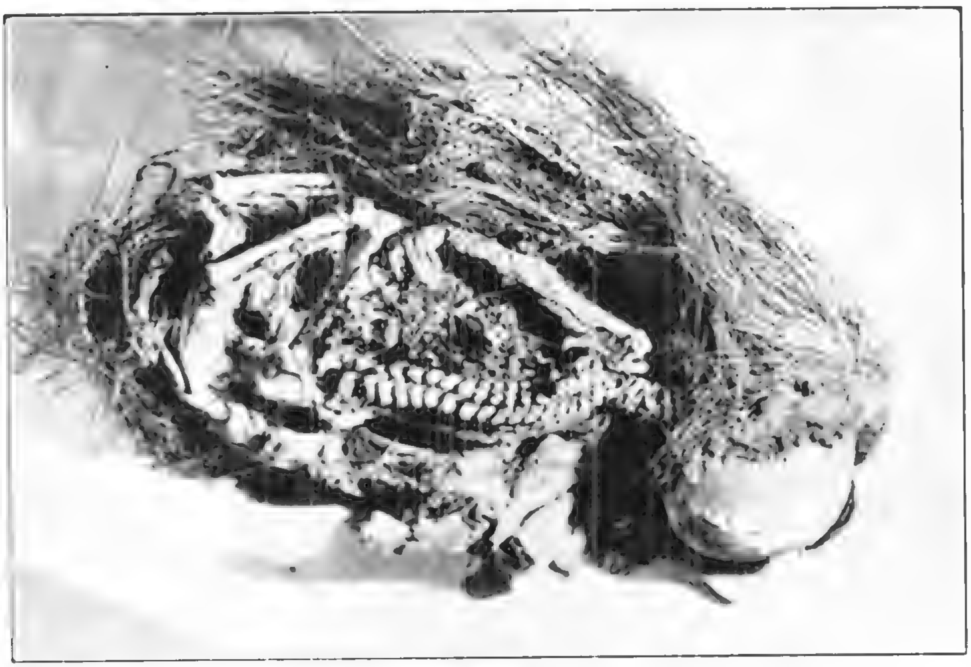


Fig. 2

Gillingham & Co. Limited, Printers, Adelaide.

NOTES ON THE LANGUAGE OF THE ELCHO ISLAND ABORIGINES.

By Rev. J. C. Jennison.

[Read August 11, 1927.]

The language of the Kokalango Mala, the name by which the Elcho Island people call themselves, conforms to the general characteristics which have been noted in other Australian aboriginal dialects:—

(1) There is an entire absence of sibilants, so that in writing the language the letter "s" is not needed.

(2) Apparently "f," also, is not required. I have no record of any word having "f" in it.

(3) Only one occurrence of the "th" sound, and that soft, came under my notice. The word was always given to me with the same pronunciation, and I have had to record it so. It is the word for soak, thiripi. To soak through is thiripi uroka warnderi. I am inclined to think this word is of Malay origin. To percolate, as water through a filter, is in Malayan tiris. In Fijian tiri is to drip.

(4) The glottal stop, as in Tongan and some other South Sea languages, is common. It most frequently occurs in verbs ending in yun; *i.e.*, jeai'yun, to split open; nger'yun, to breathe; rur'ruryun, to sprinkle. In the latter instance the pause is carried forward from its usual penultimate position to separate the duplicated syllables rur'rur. In my opinion it most often indicates the position of an elided "t." In other cases where there is no penultimate stop the "t" is heard in that position; baraityun, to throw a spear with the hand; tuptun, to throw a spear with a woomera; and so on.

In the vocabulary here presented I have included phrases and sentences giving various forms of the words as I heard them in common speech. The vocabulary is far from complete. The records were made during intervals of brief leisure amidst the many pressing duties incidental to the establishment of a mission station in wild country 400 miles from the nearest source of supplies.

A point of general interest, namely, the intrusional influence of the Malay language in Arnhem Land, may be dealt with here. Writing in 1866, or thereabout, the Rev. John Mathew declared the existence of traces of Malay influence in the native languages of New South Wales and other parts of Australia. Dr. A. W. Howitt, in "The Native Tribes of South-East Australia," writes:—"He (Mathew) says that they (the Malay words) are not numerous, are not met with in the extreme North-West, where they might be expected, but turn up in unexpected parts of Australia far removed from casual intercourse with Malays. In order to account for this Malay element he introduces parties of Malays who, either from choice or necessity, landed and became naturalised at various spots on the East, North, and West coasts of Australia. These Malays are thus supposed to have modified the speech of the people, first, immediately around them, and then landwards." After stating Mr. Mathew's views in these terms, Dr. Howitt cites the statement of the Rev. R. H. Codrington in his "Melanesian Languages," who shows that "of the twelve words selected by Mr. Mathew in support of his contention three of them, the words for sun, moon, and rain, are found also in Melanesian. Of the others, the only one that is unquestionably Malayan is *bapa*

(father), but this, or a similar term for father, is found in languages the world over."

Of those quoted by Mr. Mathew only one, bapa, is found in Kokalango, the language of the Elcho Islanders.

Dr. Howitt proceeds to quote the Rev. Mr. Threlkeld, "than whom," he says, "no one has obtained so great a knowledge of an Australian language," as denying that Australian languages have any affinity with the Malay either in word or construction. "This opinion," says Dr. Howitt, carries weight not only by reason of his special qualifications, but because it relates to the languages of South-Eastern New South Wales, where Mr. Mathew finds a strong Malay element." Continuing the subject Dr. Howitt quotes Crawfurd, author of a "Grammar and Dictionary of the Malay Language" (1852), who, he says, "speaks on the question with authority and no uncertain voice." He states that Crawfurd examined thirty languages from all the then discovered parts of Australia in quest of Malayan words without finding one or the trace of one. "They might," he continues, "have been expected in the language of Raffles Bay, not distant from the trepang fisheries of the natives of Celebes, but were absent from this as all other of the languages."

My opportunities of collecting the vocabularies of the Western Arnhem languages were limited to a few months spent on Coburg Peninsula and Goulburn Islands, but my records show unmistakable Malay influence. In Kokalango (Elcho Island) and Mau (Goulburn Islands) languages I noted the following:—

English.	Malay.	Mau.	Kokalango.
Boat	Kapal	Kabala	Kapala
Steamer or launch	Kapal api	Kabala bibi	Kapala wipi
Master ("boss")	(Balinese) Pungawa	—	Bunggawa
Bow and arrows	Anak panah	—	Buna pana
Gun	Senapang	—	Tchinapung
Money	Rupia (rupee)	—	Rupia
Bread	Roti	—	Roti
East	Timor	Jimuru	Timoro
South	Galatal	Selatan	—
West	Barat	Bara	Bara
Loose coat, as pyjama coat, etc.	Baju	Bujubuju	Baitubaitu
Father	Bapa	—	Papa
Book	Surat	Diura	Diura
Earring	Anting-anting	—	Jingjing
Tobacco pipe	Pamadutan	—	Pamatuka
Flag	Bandera	—	Bandira

I have no doubt further investigation would extend this list considerably.

I had no opportunity to collect the vocabulary of the Wurrugo, the tribe inhabiting the Coburg Peninsula, in whose language, as recorded at Raffles Bay and Port Essington, Crawfurd states he did not find a Malay word or the trace of one, but judging by the above results obtained at Goulburn Islands, 140 miles to the eastward, I feel sure careful search would reveal the existence of quite as many correspondences in the language of the Wurrugo.

I have noted a few comparisons with other native languages. The most striking instance of similarity is in the word for water, kapu. This word comes to light again in several of the languages of Central Australia, and with slight modifications is found in the languages of tribes well down in South Australia.

Dr. Basedow gives the word for water in Wongapitcha, the language of the Ullparidja tribe of the Tompkinson and Mann Ranges, on the Western Australia and South Australia border,[1] as "kapi." Among the Everard Range (South Australia) natives the word for water, as given by Captain S. A. White,[2] is "coppi."

English—Kokalango.

A Vocabulary of the Language of the Elcho Island Aborigines who call themselves Kokalango Mala (the Kokalango Tribe).

The Language.

All the sounds of the Kokalango language have their equivalents in English. They can be accurately written without recourse to the use of other letters than are used in writing the Western European languages.

1. The glottal stop occurs in many words. It is indicated by the sign ′, as in gei′yun (embrace), tir′t′yun (dip-up), where it occurs both before and after the "t" sound, ngal′yun (climb), etc. The elision appears to take place mostly in verbs, and I suggest the elided sound is of either "t," "k," or "d."

2. Ng, soft, as in singer, is written ng; when hard, as in linger, it is written ngg. All words of the latter type are also written, as in Fijian, in which "q" is used for ngg. These appear in brackets following the ordinary spelling.

3. Where double consonants are used the second is always the first letter of the next syllable; *i.e.*, watta (wind), wat-ta, except in the case of double "r," where the second "r" is used to express the lengthened roll of the "r," as in tortorr (heart).

4. The language is without sibilants, therefore the letter "s" is not required in writing it. The absence of the sibilant is strange, seeing the natives find no difficulty in pronouncing such words as sit, stand, Sam, sing, and so on.

5. In the language, as far as I was able to record it, I once only heard the sound of "th" (soft, as in through). It occurs in the first word of the phrase "To soak through," Thiripi uroka warnderi.

6. All the vowels have the "Continental" values. "U" has always the "oo" sound. The soft "u" sound, as in unicorn, is written "iu," as in niuerda (stinging bee), honey.

7. "Au" has the sound of "ow" in cow in all words where the two vowels are not separated by a hyphen. Where the latter is the case each vowel has its own distinct value.

English—Kokalango (Language of Elcho Island Tribe).

A.

Absurd, (?) manganga.
After, durdekuro.
  You come after: Ni durdekuro.
Alger Island, Balangara: Macassar name, Dambalia.
Alive, walngatiri.
Allot, bauwana: to allot work, bauwana waga.
All, daruwā.
All done, bili.
All finished, bili bangwina.
All here (are)? tuana bili. Is that all? tuana bili.
Alligator (crocodile), baru.
And, a: wa (?) after vowels.
Angry, marivuna.
Ankle, dulkun.
Another, werepungu.
Ant, koiikoii (koi-i koi-i).
Ant, green, ngarti; *(Oecophila smaragdina)*.
Anxious, anxiously, ngoiyakari.
Arm (human), wurna.
Arm, upper, near shoulder, murlo.
Armbands, plaited grass, bako: of string, narrow, jali.
Armpit, worde.

(1) "The North West Expedition," Dr. Basedow.
(2) "In the Far North-West," Capt. S. A. White

Around, liu. Paint around it: burdekuro liu ngone. As water around an island, liuyun marama: water all around, kapu liuyun marama. (See race.)
Arnhem Bay trepanging camp, Long-go-ja.
Artery, kurkur.
As (like), nakuna.
All the same as, balanyei (balan-ye-i).
Ask, tabirikaityuro ("t" very faint).
Ashamed, kōra ("o" very broad).
Asleep, ngurauakur.
Aunt, father's sister, mòkul: mother's sister, ngama.
Away, go away, maritji katchu.
Axe, takul.

B.

Baby, little, karngoto.
Baby, yuerto.
Bad, yaikuro.
Bandicoot, warntgura.
Banyan Island, Kawilingura.
Bark (of trees), dárau; kulnga.
Stringy bark, gulikàiu (gu-li-kai-u).
Bay, (?) likairayun (lika-ira-yun).
Basket, cabbage palm, guntgun or guntkgun.
Like dilly bag but thick and strong, timbouka.
Bat, dikarr.
Bathe, luptun.
Beard, (?) dau-ur (see hair of armpit).
Beautiful, mintijinmeri; a beautiful sky, mungan mintijinmeri.
Birrtyuruna (birrt-yu-runa).
Be quick, bunda.
Bee, stinging, tauwarr. Product of this bee, niuerda.
Stingless, yarapan; "sugar bag" from this one, koko.
Belch, kapoanga.
Believe, mariwalti: I believe Jesu's word, Ngara mariwalteri Jesu taro.
Belly, human, kurlun.
Belong, tiako.
Nangoui: these boxes belong to Mr. Jennison. Batimala nangoui: Mister Jennison—go.
Betroth, to a man, wawainguma (wa-wainguma q-ng-g).
Big, dumuru; iyindi.
Very big, mardumuru; miritiri.
Big mob (people), yurlngo gurlko: *i.e.*, yurlngo, plenty, big; gurlko, people.
"Big Plain" tribe name, Indingur.

Bird, warakan.
A small bird, orange-green back, white under, black head with white band around back of head, tchikai. These are sometimes caught in spider webs. (?) Lunated honeyeater.
Black, moal.
Blind, bambai (bam-bai).
Blood, manggo, manqo (nq=ng-g). (See menses.)
Blow nose, ngoritji.
Blue, milkomin.
Boast (to boast), lurugoityun.
Boat, kapala. Launch, kapala wipi, cf. Malay; steamer, kapal api. Malay origin.
Body, human, yuwal.
Boil, to, bungbungdun.
Boil (abscess), kuyal.
Bone, ngaraka.
Book, diura. (See letter.) Balinese origin.
Boomerang, hooked, niunarn.
Boomerang, ordinary type, karligarli. Known to, but not used by Elcho natives.
Born, buko-walma; cf. sunrise, walu-walma.
Has been born, bili yuptun.
Borrow, ngankdun.
I borrow, ngara ngankdun.
Boss, bungawa. Malay origin.
Bow down, yurktun.
Bow, of bow and arrows, used as a plaything, bunapana (of Malay origin).
Boy, diangi. That boy, nako diangi.
Little boy, kardako.
Boys (N.T. usage, youths or men), yurlngo.
Bosom, between the breasts, gumur.
Brag, lurugoityun.
Bread, roti (Malay), dampa (damper).
Break (as by bending a stick when man is the agent), tau'yun; (of itself), dauyuro.
Breast, woman's, ngamini.
Middle of, above breast bone, gumur (bosom).
Breathe, to, nger'yun.
Bright, ririgul (as a bright light).
Lanyin (shining as when metal is cleaned and polished).
Bring, ngango; imperative, kango. Bring me, kango rako or kango rakala.

Bring back, rongan mura.
Broad, mardùmuru (or o final).
Brother, if older, wāwā; if younger, yukoyuko.
Mother's brother, kàwal (uncle).
Father's brother, pāpā (regarded as father).
Bucket, bajikali.
Buffalo, katapanga.
Build, pochama.
Bullroarer, burralla (bur-rala).
Used in initiation ceremonies, kunabibbi. Women are not allowed to see it. The burralla is sometimes used as a paddle.
Bundle or sheaf of grass or green twigs, etc., rulu.
Bury, kurlkuma.
Bush (*i.e.*, forest or scrub country), yirpili.
To go bush, maritji yirpili.
Butterfly, burnba.
Buttocks, durde.
Buy (lit. give something), kuropan.
By and by, yallala.

C.

Cabbage palm (on Elcho Island few and small), darrang-ngi (dar-raqi).
Cadell's Strait—1, between Elcho and mainland, Maiyung; 2, between Howard Island and mainland, Gurrar.
Calf of leg, yangara.
Call, watun (wa-tun).
I call, watun mukatara.
You (sing.) call, ni waturo.
You (plu.) call, waturana.
Calm, George, "Water like glass, no wind," wapurara.
Camp, wārnga.
Canoe, lipalipa.
To cut out a canoe, jaralktun dulmo.
Capture game, ngaiạtama.
Caterpillar, a very large kind, dapelin; a small green kind, dalaikman.
Carry (you), carry load, kurokongo.
I carry, ngara kurokama.
You carry, ni kurokongo.
To carry on head, kurokama liye.
Cartridge (gun), ngak-ngana.
Cave, gurnda maer (gurnda, stone or rock)..
A refuge cave, mertlili; running to refuge cave, warnderi kari mertlili.
Centipede, laitjin.
Cheek, takal.
Cheeky (insolent), marakari.
Chew, nyank'dun.
Child, little, karnggoto (karnqoto); little boy, kardako; little girl, yuertua; bigger child of about four to nine years, tumurana.
Chin, taumanupman.
Choke, karaktan.
Chuck away, jalkturu.
Circumcision corrobboree, jungguwan (junquwan).
Circumcise, kurka daktunaui.
Clap hands, lur'yun.
Chiton (*Squamosus*), jirika; (*Acanthopleura*), karlkiya. (See Woodward, pl. xi., No. 29.)
Clean, daritjal.
Clean it (imp.), daritjal nggo (nqo).
Cliff, tarndar.
Climb, to, ngal'yun.
Clock, walu (sun).
Close up (near in time), barait.
Close up dead (N.T. phrase, nearly dead), barait tinggama (tinqama).
Close up (near in distance, nearby), kalki.
Cloud, mungan (mung-an).
Big, mungan dumuro; little, mungan ituala.
Cockatoo, black (*Calyptorhynchus funereus*), arteli; white (*Kakatoe galerita*), tang-gi (tanqi).
Cockles, ngakainu.
Cockroach, bordok (both o's short).
Cold, ngolwit.
Cold wind, watta ngolwit.
Come over, burapturana. When did you come over? (across the strait) Natan numa burapturana?
Come, maritji go.
Come to the house, maraitjini balalili.
Come quickly (imperative), maritji burndi.
Come back (imperative), rongi.
Coming again, Jesus is coming again, Jesus mukato maritji.
Constellations, names of—
Milky way, Baduro (river). The Arnhem native says the Milky way is a river.
Orion's belt, Julpan. Elcho people say it is a canoe.
Orion's sword, Yaratar. A fish caught by the man in the canoe.

Pleiades, Jungarliwar. A baling shell, *Fusus antiquus* (Woodward, pl. v., 8).

Southern Cross, Wurdegugu. Natives say fire is burning there all the time.

Commit adultery, nukulu.

Command against (forbid), yaka ni.

Conus marmoreus, bermulla.

Coral, kārrār (kar-rar, a's very broad. See dew).

Cover up, belturo.

Cousins: Man speaking—

My father's younger brother's son (I call him), yukoyuko.

My father's younger brother's daughter (I call her), yapa.

My father's younger brother's daughter (she calls me), wāwā.

My father's elder brother's son (I call him) wāwā.

My father's elder sister's son (1 call him), duwai.

My father's elder sister's daughter (I call her), duwai.

My father's younger sister's son (I call him), duwai.

My father's younger sister's daughter (I call her), duwai.

The duwai would call me kalai.

The duwai child is called kurung.

Crawl on hands and knees, ngar-nung; karl'yun.

Creek, maiyung.

Creeper, edible root, heart-shaped leaf, barwung.

Crescent, crescent-shaped, ngarlindi.

Crocodile Island Group, called by Elcho people Warnba.

Crooked, jari-pi.

Cross, ☩, maitkar or matkar.

Crossed sticks, nggarndro matkar komar (Sticks, nggarndro, nqarndro). Jesus died on the cross, Jesus tinggama maitkangura.

Crow *(Corvus)*, wark, sometimes wark-wark.

Cry (weep), ngarti. (See ant.)

Cut, as with axe when felling a tree, tanggiritun (taqiritun); with knife as in sharpening a pencil, raiuntjun; with knife or axe as in shaping timber, jaruktun.

Cuttlebone, ngun-ar-au-ar.

Cut open, raktun.

Cunningham Islands—

South Cunningham, Karlu.

Middle Cunningham, Pumoka.

North Cunningham, Tauwuru.

Cycad *(Cycas media)*, ngato; fronds, barng; fruit, warakar; pineapple-shaped top, burlgo.

Cyclone, jarwan.

Cypress pine *(Callistris)*, lanapo.

D.

Dance, as in corrobboree, kerecheri or kerejeri.

Dark, muna, muna-u; of sky when heavy rain is coming, moal.

Day, bun-gu-gu or bungonyu; mid-day, walupi.

Daughter, kato.

Dead, ting-gama (tinqama).

Deaf, buturomiru.

Decide, ngurkama.

Delirium (of sickness), bau-watun. Watun, call.

Desire, sexual, form of expressing, batan durana.

Devildevil, morkoi.

Dew, mendok.

Die, tinggama.

Dig (as digging yams, grubbing trees, etc.), belama.

Dig a well, me-el belama.

I dig a hole, Ngara belama mer.

You dig a hole, ni belango mer.

Charlie dug a hole, Charlie ka belama mer.

Dilly-bag (of pandanus leaf), yarlka; (made of string), kaikua (final "a" almost silent).

Dingo (tame), wartu; (wild), wakin-gu.

Dip up in hand, tirt'un.

Dirty, moimeri (or moimiri), kanot.

(I) have dirty water, kapu kanot mir-ra.

Disrobe, yupmarango.

Dive (to), luptun.

Do, bi.

Dog, wartu.

Door, durwarra.

Dove, ku-kuk.

Down, yirpturu.

Drag, lundo maritji ngora.

Drank, ngulkturo.

Dream, bokàwai (bo-kà-wai, accent on second syllable).

Dress (woman's), kopaia.
  To dress, neroluna.
  Put on (this) dress, neroluna kopaia.
Drink, ngulktun (imperative).
Drinking (noun), ngulkturuna.
  Is (your) drinking finished? Bilina ngulkturuna?
Drop (of water, etc.), jurl'yun (sometimes a "k" is heard, jurlktun).
Drop, to, yuptun.
Drop and break, buluwang-duruna (sometimes sounds like buluwank).
Dry, jurro.
Dry season, ngàraner.
Drysdale Island, Yeringa.
Duck, mutali.
Dumb, torngulu.

E.

Ear, botoro.
Ear-ring, jingjing. (Think this used of gold ear-rings only.) Having gold ear-rings, boton jingjing meri.
Earthquake, warnga waraka kurkuriun. (See Camp.)
Eat, luka ("u" short).
Edged tool (as chisel), yiki.
Elbow, likan, nurnggur (nurnqur).
Elcho Island, Kaliwinko. Macassar name, Takarina.
Elcho tribe, call themselves Kokalango Mala. Includes the Drysdale islanders.
Embrace, to (with arms), gei'yun.
Emu, urpan.
Encourage (make strong), darlkongo.
End, boko. (See hill.)
Enemy, tu wali yait marikari.
English Company's Islands, Wartuta.
Enough, bilna dunung, nabili; that is enough, tu wali nabili; bilina.
Eucalyptus, kuderi (has very broad leaves).
Evacuate (stool), berltun.
Everlasting, dunggara raradara (dunqara).
Everybody, limarurgo, or rungo by itself.
Every night, munamuna.
Every day, biako bili.
Extinguish, bunwaiokongo.
Extract, to (as letter out of envelope), jauwarikuro.
Exchange (swop), bokoyurlk.
Exchange of lubras (a native custom), boko-yurlk meal.
Excreta, kurla.
Eye, mel (pr. male).
Eyebrow, milkiningin.
Eyelid, milparamba.

F.

Fall, down (as off a cliff), kalkeri.
Falsify (gammon), nyartyun.
  It is false, yaka tu wali nyarl. (Yaka, no, not.)
Fan-palm (*Livistona inermis*), wuriara.
Far away, barako.
Fat (noun), gutarr; marlngo. Yinda is used with both, gutarr yindi.
Fat (stout), marlngo.
  Fat white man, marlngo yindi balanda.
Father, pāpa (first "a" very broad).
Feared (high) ground; *e.g.*, hill on north side of Waiya (N. Goulburn Island), warnga boko marakari.
Feel, to, ngaiyatama.
Feel about, kongalgal yuro.
Feeling, gar.
  Feeling sick, erikton gar.
Female organ, dala.
Fig (wild), kaitji.
Fight, to, bonàmeri (accent on second syllable).
Finish (the), belina.
  "Close up finish," tauwartyuna.
Finished, bili.
Fingers, turnggal (turnqal).
  To close fingers, ngguudau yura.
Finger nail, darerr.
First (as in front), ngatili. "I first," Ngara ngatili.
Fire, kurlta.
Firefly, jangapun.
Fish (any kind), kuya (some times pronounced guya).
  A brown spotted fish, ngurtali. Salt-water.
  A small freshwater fish, burrija.
  Another freshwater fish, rimu.
  A small saltwater fish, lopa.
  A short white saltwater fish, dur-apa.
Fishing, "Tom (wants) to go fishing," Tom kuya lili maritji; "Tom has gone fishing," Tom kuya lili maritjina.
Fish-hook, bikang.
Fishing line (European make), balandi. (See White man.)
Fish spear, makur ("a" short). This spear is made with three or four points.
Flag, bandira. (Of Malay origin.)
Flames, burdaiyala.

Flash, flashing; of lightning only, melk-melkdun.
Float, to, burktun.
Flower, wurki.
Fly, to, burtun.
Flying ant, jangapun. (See Firefly.)
Flying fox *(Pteropus)*, dikarr. (See Bat.)
Fog, karran.
Follow, malturo.
Follow me, malturo rakala.
Folds of flesh or hollows of the groin, gurnbai.
Food, ngata. "(Where is) George's food?" Nganaka George-go?
Fool, malton.
"You are a fool!" Ni yait-bili malton.
"You fool!" Tu-wali bili nungu malton. (Lit. That fool belong you.)
Foot, punggina (punqina), jalkari.
Footmark, luk-or.
Forehead, boko. (See hill.)
Foreskin, ba-ru-warn.
Forget, moma, norma or mongo.
"You must not forget," Yaka ni mongo.
Forbid, yaka-jama.
Former (N.T. phrase, "first") time, ngoli jurlktun.
Fornicate, nukanaui (nuka-nau-i). Used with maritji, come; maritji nukanaui.
Forsake, woteri.
Four, murnda-bulal-murnda-bulal.
Frightened, burarei or bararei.
Froth of waves, white, karrara.
Fruit, any kind of bush fruit, burlgor.
Fruit tree with large soft ivy-shaped leaves, tanqi.
Fruit tree, leaves, compound (triple) oval; fruit, good; urndarn.
Fruit tree, oval leaves, rough bark, barmarang.
Sandpaper tree, good fruit, mut-te.
Full up, tangang.
Fur, kangaroo's, bulkar.

G.

Gammon, to, nyartyun.
Gate, tokai.
Generous, tapinya (accent on second syllable).
Get ready, bundinini (second and last "i" short).
"You get ready quickly," Amonga meriuar bundi.
Get up, rur'uro.
Girl, little white, yurto itchuala-nong.
Girl, little black, nimukurnin.
Give, kuropan, ngaiyatulu, kuropulu.
"I give you (this) kangaroo," Ngara nongo kuropan wirti.
"(You) give me that," Ngaiyatulu tu-wali.
"Give me a fish," Nga-rako guya ngaiyatulu.
Kuropulu is a Howard Island language word. It is quite often used by the Elcho islanders; *e.g.*, "You give me a knife," Ni kuropulu lati nungu.
Glad ("heart glad"), ngoi ngamati.
"I am glad"; lit., "I am glad along heart" in the Kokalango idiom, Ngara ngoi ngamatina.
Goanna, janda.
Go away! (imperative) Katchoì!
Go away, bili maritji. (The) spirit goes away, Berimber beli maritji.
Go bush, maritji yirpili.
Go wrong *(i.e.,* take wrong track), yait jangu maritji.
Good, men-mak (pr., mainmack). Second "a" very short; used for nice, pleasant, and so on.
Good, namakuli (Jambarapi section of tribe); namakuro (Kopapiungo section), excellent in quality, as good timber. A word of loftier meaning than menmak.
Good, makolili, in the sense of perfect, finished completely.
Goose *(Anseranus semipalmatus)*, kuromurtji.
Goulburn Islands, Manggauuta.
Grass, waimi.
Great, dumuro.
Green, karnamintji.
Green ant *(Oecophila smaragdina)*, ngarti.
Green ant's nest, yal-lu.
Ground, tjurlka.
Growl, to (in N.T. to scold or rate a person), marivuna.
Gun, tchinapung. (Malay, senapang.)

H.

Hair of head, mura or mara (both right). If short, jamari marawat.

Hair of puberty: male, balmar; female, ngulomurung.

Hair of armpit, dau-wurr.

Hairbelt, martart.

Hammer, to, wuttun.

Hand, kong.
 "Hold out (your) hand," Kong layiro.

Handle (as of lantern, bucket, etc.), jimurndi.

Happy (to make), burltyun.

Hard, ngundungar.

Hat, jorngo.

Has, appears to be indicated by the suffix meri in the case of possession by some thing, not a person. The bucket has a hole, baket turdi dalkameri.

Have, I have, ngara kala.
 You have, no kala. N.B.—*It is* no kala, *not* ni kala.
 He has, nanu kala.
 We have, limaru kala.

Hawk, white-breasted sea-hawk, tamala.

He, ngama; tu, reflexive, follows the name, subject.

Head, liya.
 On head, as (carry load) on (your) head, liye.

Head man, ngura darwarlango.

Heap, boko ngalp-mera.

Hear, I hear, ngara ngama.
 You hear, ni ngama.
 He hears, ngaii ngama.
 I did hear (I heard), ngara ngoli ngama.
 They hear, nguna wallala ka ngama.
 I shall hear, ngara galkun yallala ngama.

Heart, tor-torr; "r's" rolled.

Heaven, karu-warr; "r's" rolled. "Camp along Heaven," warnga karuwarr.

Heavy, ngornung.

Help, to, gun-gat-yuro.

Here, duala.

Hermit crab, gormo.

Hers, nguroko. This flour is hers, tuwala roti nguroko.

His, nguno. His dog, nguno wurtu.
 tiaki. This flour is his, tuwala roti tiaki.

Hit, to, (I) hit, wuttun.
 (You) hit, wurtero.
 (He or they) hit, wu-tu-rana.

Hold out (in hand), layiro.

Hole (in garment, bucket, etc.), dalakar.

Hole (in ground), mer (pr. mare).

Hole (in septum to put ornament through), nguro dalakar.
 Stick for insertion in same, nguro kandrupmeri. The "p" is scarcely heard.

Honey, koko, niuerda. (See Bee.)

Honour (respect), namakuli.

Honour, to, waga tarlti dari tunupa.

Horn, horns, tandurung.

Hornet, niuwà-niuwa.

Hot, nara; gormur.

House, bala.

How? naltjan? Usually followed by ni.

How far? dika warnganja?

Howl (as dingo), n'yoiyun.

Hungry, jungara. That boy is hungry, tuala yurlngo jungartina. I am hungry, ngara jungarteri.

I.

I, ngara.

"I say!" (a call to draw attention), wallala!

Idle, yakurtumuru.

In, ngain (nga-in). "In the name of," ngain yako.

In, taramulo.

Initiation ceremonies, gormul.

Initiation ceremonies, corrobboree, kunabibbi.

Inside, deripi.

Instead of, maltun. "Instead of him," ngara maltun nango.

Island, takal.

Island between Elcho and Drysdale Islands; two names are in use apparently, Karuwuru, Niukar-meringora. Up to 1921 this island had been no more than very indefinitely indicated on the Admiralty charts.

Island north of Drysdale Island, Bukunkna.

Island north of Bukunkna, Wuntberi.

It, ngone.

J.

Jabiru, the black and white crane of the Territory, kanji.

Jaw, darno.

Jawbone, darno ngaraka.

Jealous, man-otchi-di'yun (manotchidi-'yun).

Jelly fish, murlul.

Jelly fish, a stinging variety ("cheeky fellow"), gaiwarr.

Jerk, wariuk-wariyun (the "k" is barely heard).
Job, jama. (See Work.)
Jolly, biarima.
Jowl, takal. Same word as for island.
Joy, ngoi-ngamateri.

K.

Kangaroo, narrko.
Kill, wut-turra.
Kill with spear, tarpungo.
Kind, meluiyuna tumuru.
Kindle (a fire, etc.), malpulo (kurlta malpulo).
King (head man), Kare. The tribes do not have kings and there is no hereditary leadership. The man of strongest personality for the time being is the leader. The whites have introduced the term, and the natives now use it in an indefinite way.
Kiss, to, junkjungdun.
Knife, lati.
Knob, bur-lon-gun.
Know, murngi; I know, ngara murngi.
Kookaburra, N.T. species, karokal.

L.

Lame, karnung.
Lamp, landira.
Late, too, ? toritna; "You come too late." Yallala toritna maritji.
Laugh, to, kitkityun.
Lead, to, unagama.
Leg, muk-ar.
Lend, korng kuropan wariko.
Letter, diura. Malay, surat.
Letter stick, karndru nga-munga-me-en.
Lie down, nguri.
Life, walngar.
Lift, to, lau'murra.
Lift! (imperative) Lau!
Light (glow or flames), burdaiyala.
Light, to (Light a fire!), tongur (imperative).
Lightning, melkdun.
Lily roots, derepu (der-e-pu).
Lip, tu-wu ar-ra.
Listen, ngama.
Listen, "Everybody listen," butiro bidjiro.
Little, itjuala.
Little, very little, mar-itjuala.
Lizard, kurnjulu.
Load, to carry, kurokama.
Load, to carry on head, kurokama liye.
Load (noun), meltun. Big load, miritiri meltun.
Loincloth, jarijari.
Long, lamberi, wiyin, gurere.
Long, very, maroiin (mar-o-i-in, possibly the correct form of the word is marowiyin).
Look, I look, ngara nama.
You look, ni nango.
He looks, ngurunga nangala.
Look! or look here! inguna!
Lose, morma.
Loudly, ? meritiri. Surf roars loudly, kapu rirakai meritiri.
Love, to (transitive), ngoingamatiri. This term agrees very imperfectly with our word "love." It appears to mean more exactly "rejoice in or over" or "find pleasure in." (See Joy.)
Lubra, meal. "That lubra is sick." tuali meal erikton.

M.

Macassar (country), Kambomaliko.
Make (you make), kabuma.
Make water, wariyun.
Make a sail out of bark, ngamungamaiyun.
Man, yurlngo. Old man, arlapal.
Mason bee, e-ring-a (accent on second syllable).
Maternal grandfather, ngati.
Maternal grandmother, mari.
Me, rako. You give me a fish, Ngar, (?) you; rako, me; guya, fish; ngaiyatulu, give.
Mean (adj.), laidāl. Mean man, laidāl yurlngo.
Melo diadema (shell), (Woodward, pl. vii., fig. 11), kurn-ngari.
Menses, first occurrence of, miliwirin. After first child, manggo (manqo). (See Blood.)
Message, dawo.
Messenger, dawo gango.
Middle, būra.
Midwife, ngaiatama.
Milk, ngamuntgur.
Mine, narako. "This flour is mine," tuwali roti narako.
Mistake (to) one thing for another, burdait.
Mob (people), yurlngo gurlko; lit., big mob.
Money, rupia (of Malay origin).
Moon, full or nearly full, walmura. Said to be a man, the sun's husband.
Moon-rise, walmura walmar.

Moon, new, ngalindi.
More, bulo. "I want more," ngara ngai bulo.
Morning star, banober.
Mosquito, generic term, melkmelk.
Mosquito, anopheline; (stands upright to pierce), tanbul.
Mosquito screens, cone-shaped, ngunmurra or gunmurra. First discovered by the compiler of this vocabulary on Murungga Island, 14th September, 1921.
(To) Mother (*i.e.*, as lubras sometimes mother orphaned children), nggong (nqong).
Moth, gunba.
Mouse, manbul ("u" short).
Moustache, bulotchomi.
Must, mar. "You must go," ni mar maritji. (See Very.)
Mould (on boots and fungoid growth), borloko.
My, rako. "Bring my water," Kapu rako ngango.
My, arakora. "My little girl," arakora yertua.

N.

Name, yako. New name, yieurta yako.
Narrow, goarlbar.
Native companion (bird), gurdurko.
Nautilus radiatus (Woodward, pl. ii., fig. 10), ngarlindi. The opening is crescent-shaped, hence also the new moon is called ngarlindi.
Navel, giniger.
Near by, kalki (actually near). Relatively near, kalkina. Sometimes the word is pronounced galki, galkina, etc.
Near house, bala kalkiwait.
Near, dikana (galki). When used of person coming apparently means now arrived or present.
Nearly finished, galkina or kalkina.
Near, "Joni is near," Joni kalkina.
Neck, maiyang.
Nest, yelo; sometimes pronounced like yaelo.
New, yiurta.
New moon, ngalindi (crescent).
News, dao.
Night, munau (mun-a-u).
Nipple (of breast), nguro ngamini.
No, yaka.
No good, yaikuro.
No matter! baidi!
Nothing, na-miren.
Nose, nguro; kamuro.
Nose stick (worn through septum), nguro kandru (p) meri; hole in septum for same, nguro delakai.
Nostrils, nguro dalakar.
Now, tuanavela.

O.

Old, ngartilingo.
Old man, arlarpal.
Old woman, karkarung.
One, wanggain (wanqain), nguna.
Oneself as agent; the suffix yuro signifies done by oneself.
Only one, wanggain (wanqain); bini wang-gain.
One belong everybody, riako runggo, bili (runqo).
Open, to open, as door, laupmurra.
Orchid, grows on Cycad boles, fine flower, jalkur.
Others', other man's, werepungua.
Out, go out, warlma; take out, dauwarimurra.
Outside, wārngul.
Over, ngapalili.

P.

Paddle, marowala; to paddle, guruma.
Paint, yellow, butalak (last "a" short).
White, kapirn.
To paint a design on a person, burdei'yun, pronounced almost as if "t" preceded the "y."
Red ironstone paint, miku (mik-u).
Palm of hand, tungal tulmur.
Pandanus (*Pandanus adoratissimus*), kung-gar (kunqar).
Paperbark tree (*Melaleuca*), parokala; bark of, rakala.
Parrot, bilit.
Parrot-fish, lalu.
Past (time), jurlktun.
Path, tokar; in jungle, partuar.
Paternal grandfather (father's father), marikmo; grandmother (father's mother), mormo.
Pay, baiyara.
Peace time, diangubela daurdauyun.
Peace, daurdauyun.
Peace come, bonameri limuru ka belina; lit., Our fight is finished.
Pearl, gulàwu. Accent on second syllable.
Pearlshell, rimurralngo.
Penis, kurka.
Picture, mali.

Pigeons, brown, laparr; black and white, rombura.
Pine, cypress, dwarf variety, pundit.
Place, feared, warnga marakari.
The hill on Waira (North Goulburn Island), held in superstitious fear by the local natives, was spoken of by the Elcho people as "Warnga boko (hill) marakari.
Plane, to, wirityun.
Plate, manggo (manqo); same as blood.
Play, bultyun.
Please (give me), ngalewa rako.
Plenty, gurlko.
Plug (or bung), tungouna.
Point, as of land, karmuru.
Policeman, upata. Crocodile Is., upaja.
Pony, yaraman.
Pour, to, rariyuro.
Pray, wanga; lit., talk. (N.B. camp, warnga.)
We pray, wanganaui.
They have become accustomed to the use of the English word, but use it with the vernacular suffixes: Ali pre-ena, we two pray; limur pre-ar, we (small number) pray; pre-a-lili, we (many) pray.
Presently, tura.
Present (time), diangubela.
Pretty, mintijimeri or mitjimarmaipa.
Protector, as shepherd of sheep, jaga; lit., watcher.
Promise in marriage to a man, wawaing-guma (wawaing-guma, wawaingquma).
Prow of canoe, ngoru. (See Nose.)
Pumice, mundomundo.
Putrid, burpar.

Q.

Quarrel, to, worlworliyun; yaityaiyun.
Quarrelsome, meriteri yaityaiyun; mure, bitjan bitjan bili.
Question, to (ask), tabirikaityuro.
Quick, bundi (come).

R.

Race, wurndiri.
Race winner, wurndiri julkmarama or wurndiri jurlkton.
Rain, barlman.
Rainbow, papijari; lit., Papi's stripes. Papi, a snake.
Rat, marawurti. (See Dog.)
Raw, tarngodiko ("i" short); tarn-go-dik-o.
Red, mikopmeri (the "p" is hardly heard).
Red paint, nipirn.
Reef, gurndalili. Gurnda, stone. Lili appears to signify a quantity of.
Remember, kuiyanga.
Reside ("sit down"), kanina or kan-nina. (See Rest.)
Rest, "I rest," ngara kannina.
Revolver, tchilitchilika. Apparently onomatopoetic. An endeavour to reproduce the sound of the lock action.
Reward (pay), baiyara.
Rib, maderi.
Ridge of house, dentji.
Meeting in a ridge, $\wedge$ tunaui.
"Right-o," pana.
Road, tokàr.
Roar of surf, rirakai (ri-rakai).
Roof, double-sided, $^1\wedge^2$, malakmalak tunaui.
Root, big roots, tap root, etc., mukar.
Root, small, fibrous, raki or rake.
Rope, rake (ra-ke). Native rope is two-ply.
Rough, as timber before planing, ngai-yakngaiyak.
Round (circular), belkbel.
Rub, yarragaityun.
Run, warndi or warnderi.

S.

Sail of boat, canoe, etc., karoro.
To sail, kakarkajì (accent on last syllable).
Saliva, larakura.
Salt, jl'la (almost jìala).
Sand, munata.
Sandbank in sea or channel, baràla.
Sandfly, kaitcheri mindikmindik.
Sandhill, boko munata.
Saviour, Walna; your (one) Saviour, Walna kuma; our Saviour, Walna kunaemeri.
Saw, to (verb), teregeyun.
Say, bitjan.
"I say" (calling a person's attention), Murnda. "Hello!"
Scrape (verb), yiripan.
Scrub plant, lanceolate leaves, yanyeri.
Scrub tree, very hard wood, tomomo.
Scoop up, with hand as when drinking, tir't'un.
Scorpion, jartam.

Screen for baby, tiltji. This is a pie-dish-shaped screen of plaited pandanus leaves used to screen children from mosquitoes, flies, etc. It is made in the same way as the gunmurra (cone-shaped screen), but differs in shape. It is also used as a carrier for very young babies, and for that purpose is simply inverted, the child lying in the concavity; when so used, it is called a tolmi.

Scrotum, burrungur.

Sea, tirlavan. Malay, colloquial; lautan.

Seaweed found on boat bottoms, niuarl.

Seaweed or growth like miniature trees of a substance resembling horn, bongavato.

Seasick, wanuruma.

Seed, seeds, ngaraka.

Seed cups of eucalypts, gorngaro (gor-ngaro).

Sell, mali.

Semen, dien.

Send, I send you, ngara nuna datun.
You send, ni daturo.

Sexual intercourse, nukan.

Sexual intercourse, to solicit female, nukanaui.

Shadow, mali. Also used of photographs and pictures.

Sheaf, rulu.
to tie in a sheaf, rulu garepin.

Shell *(Fissurella listeri,* Orb., Woodward, pl. v., 1), tungo.

Shin, bākā.

Shining, or flashing, of lightning only, melkmelkdun.

Shining, of things generally, mirra.

Shirt, baitjubaitju. Malay origin.

Short, kureri. Short stick, karnduro kureri.

Shovel, to (stir up with shovel as when mixing concrete), kaliwu.

Shovel (noun), jiru.

Shoulder, milipi (mi-lìp-i); accent on the second syllable.

Shout, to, wartun.

Show, kuro.

Shut, kungama.

Shrub, a yellow-flowering, titi (tit-i).

Sick, eriktun. "Are you sick?" Anakar ni ka eriktun?

Silly, manganga.

Silverfish (insect), burdok.

Silver-leaf tree, yau-un.

Sin, ngardi; jiri.

Sink (in water), kourokouliun (sometimes gourogouliun).

Sink or dive, luptun.

Sinker for fish line, lato.

Sing, miyaman.

Sister, yapa.

Sister of father (aunt), bapa.

Sister of mother, mokul.

Sit, nini. Sit in row, wanggai nini.

Skate (fish), barndro.

Skin, barowan.
To skin, luluknurra.

Sky, kunduru.

Slack (verb), to slack off rope, yali-yalktun.

Slack (adjective), yalk.

Sleep, ngura.

Sleeping two together in camp fashion *(i.e.,* fire, man, man, fire, man, man, fire, and so on), ngalingura galki.

Sleeping (or stumpy-tailed) lizard, yeargali. Another kind with pointed tail, lergar.

Slow, bulnar. Come slowly, bulnar maritji. Note, adverb precedes verb.

Smash (as smash a plate), buluwank durana.

Smoke, ngurmar.

Smooth (adjective) of surfaces such as a planed board, boiyowoiyo.

Sneeze, aitjiri. When a person sneezes they say, "Someone is calling." The sneeze is supposed to be the involuntary response, equivalent to "Yes, hallo!"

Snipe (bird), turing-ga (turinqa).

Soak through, thiripi uroka warnderi; soft "th."

Soldier (fighting man), nopanmeri.

Sole of foot, tulmo jalkeri.

Soft, yalngi.

Son, if own son, kato; if another's, kato meringo.

Something, na-kakari; na-kangura.

Sorrow, warugogo.

Sour, lerakaiyuna.

Spatula, jiru. They are generally made of wood and used as spoons in eating food.

Spear, karra.
To spear fish, turtle, etc., bile.

Spider, large black and white, catches small birds, karr ("r's" rolled).

Spiderweb, maraluma.

Spill, ngurkungu.
Spit, narakura.
Spirit, berimber.
Split, to split open, jeai'yun (je-ai-'yun).
Springs at Mission Bay, Elcho Island, Wung-gung-gul (Wunqunqul).
Sprinkle, yur'tyun; rur'ruriyun.
Squeeze in hands, meritjan.
Stand, Stand up! tara.
Star, ng-gainyu (nqainyu).
Steady! go steady! bulna.
  Restrain! not so hard! kung-ga (kunqa).
Steal, munangi.
Steps (as the front steps of the Mission House), toka.
  To be distinguished from tokarr, track.
Stern, of canoe, etc., hinderpart (tail), durde.
Stick (wood), karndro or kandru.
  Long stick, nullanulla.
  Sticks crossed *(i.e.,* two sticks laid across each other), matkar komar.
  The cross (Christian sign) is called matkar.
Stingaree, kaukalung.
Stomach (belly), kulun.
Stone, gurnda.
Stone spear, ngambi.
  Stone head of spear, ngambi.
  Shaft of spear, warrawurra.
  Wax used for fastening head to shaft, kalanyon.
  String for same, raki.
  Socket depression in shaft end for taking woomera hook, milak.
Storm, bauuto (bau-uto).
Story, dawo; dao.
  To tell a story, dao lakrama; raka lakrama.
Straight lines, ==, tunopa wariuro.
  To saw straight, tunopa dakturo.
String, kurkir.
  Another kind, used in dilly bags, waitja.
Stringy-bark tree *(Eucalyptus macrorrhyncha),* garaika.
  Bark of, gulikaiu.
Strand, to, run ashore or on reef, etc., ngalyun gurndalili.
Strong, miritiri dahl (or darl).
  Make strong, darlkongo.
  "Come strong again," gain strength after illness, etc., dahlterina maritji.
Striped in colours like rainbow, jari; jari daruwur.
Suck, bointbointyun.
Sugar-bag corrobboree token, barangol. Used to summon tribes to the corrobboree.
Sugar-bag (honey), from the non-stinging bee, koko; from the stinging bee, niuerda.
Sulu (loincloth), jarijari.
Sun, walu.
Sunrise, walu walmar.
Sunset, walu karina.
Sundew, naman.
Suppose, goli.
Swallow, to, dalokaroroandi.
Swallow (bird), mulunda. In Howard Island dialect, jiirrpari (ji-irr-pari).
Sweet, takai menmak.
Swim, to, waii'tun (wai-i'-tun).
Swelling in groin, durkulo.

T.

Table, pati.
Tail, paka. Bird's tail, durde wien.
Take, marangala. "Who took the axe?" Yurlto marangala takul?
  I take, ngara marama.
  You take, ni manngo (man-ngo), manangi.
  He takes, ngurungo marangala.
Take wrongfully (to), to steal, kango munangi.
Take off dress (undress), yapmarango.
"Take this letter to Yoram," Dura tuwala kango Yoram-wala.
Tale (story), dao, tao.
Talk, to, wanga.
Tame (adj.), ngamakuru.
Task, jamauwa (ja-mau-wa).
Taste, to, karamun (kar-a-mun).
Tea-leaf, kokoa.
Tears, milkari.
Tell, lakrama; wanga or wangi.
Tell (talk), wangi.
Tempt, ngaiyan.
Testicles, kumanga.
Thank you, tapi ("a" short).
That, yali; tuwali.
The, nuna.
Theirs, wallalango (wal-la-lango).
  That bread is theirs, tuwali roti wallalango.
There, nguna.
They, wallalango.
Think about, reckon, kuyangi.
Thing, na.

This, tuwala.
Throw away, jalkturu.
Throw spear, baraityun (with the hand, not woomera).
With woomera, tuptun.
Throw stone or missile, ngorkongo; ngorkama.
Thumb, yindikngo.
Thunder, nira (both syllables strongly accented).
Thwart of canoe or boat, wurda.
Tide, riyalla (ri-yal-la).
Flowing, riyalla ngruteri.
Ebbing, riyalla tokaiaieri (to-kai-ai-eri).
Tie in sheaves, (rulu) garepin.
Tight, tanaitmurra.
Tight enough, bilina tanait-tura (lit., finish tightening).
Tired, kalnga gurkurir.
Toadstool, barngani (bar-nga-ni).
Tobacco pipe, pamatuka (Malay, pamadutan). It is the Malay type.
To (a place), suffix ona to place name: Tom went to Kaliwinko, Tom tarara unuma Kaliwinkona.
To-day, gatura. I saw them to-day, ngara nangala gatura.
To-morrow, yorng-gongo.
To me, rakala, rako.
Toe, toes, pirning.
Tongue, mata.
Too late, toritna. You (are) too late, ni toritna.
Too much, meriteri.
Tooth, lerra, or learra (le-arra). Sometimes pronounced lira.
Top, ngapunguru.
Tortoise shell, karopo.
Track (pad, path), tokar, tokara. I know the track, ngara nguni marangi tokaro.
Track, jungle track or road, patuar.
Track of animal, warmalinggar (war-ma-ling-gar).
Tree, generic term, gaiyu.
Small tree, oval leaves, white underside, mottled bark, kuranmula.
Tree, thick foliage, caulking gum extracted from roots, maipin.
Trees from which rope is made—
1, balgoro, the "sandpaper tree"; 2, baro; 3, barata. The bark of the barata is used for sails.
Trepang, boleri.
True (of self), bili; (of others), yual.
It is true (of something the speaker has said), nar ko bili.
Jesu's word is true, Jesu taro yual.
Trumpet, native wooden drone pipe, iraki.
Turn away, ngapabilyun.
Turn over, ngurkungu.
Twitching of muscles, tovi. Said to have sinister meaning or otherwise according to what muscle is affected.
Twist, as in making string, berereyun.
One's own arm, wurnar bilyuro.
Two, bulal.

U.

Ugly, yaitkuro.
Uncle, mother's brother ("brother along mother"), kawal (ka-wal).
Under, an.
Undo, yeupmurra.
Undress, yupmarango or yeupmarango.
Up, ngalturo.
Upper, ngapunguru.
Use (verb), kaluki.
Urinate, wariyun.
Us (many), limurung-go (li mu-rung-go)
Uttermost, da-ultun.

V.

Vein, veins, kurkur.
Very, mar.
Very good, mar anamakuru.
Vine, wild, kanima. Fruit of, borum.
Vomit, danguruyuptun.

W.

Wait, kalkun.
Wake up! tari (lit., stand up).
Walk, tjitjarion or tjitjariyun.
Want, desire, maramba.
Want, ngai; as "I want a drink." Ngara ngai kapura ngultun (lit., I want water to drink).
Wash, ruruwaiyun.
Wash all over, to, bili ruruwaiyun.
Washing (the), ruruwaiyurina (as in the sentence, "I have finished the washing."
Watch, to, meltun.
Watch, to (as a shepherd over his flock or a sailor on a boat), jagga (jag-ga).
Water, fresh, kapu; sometimes pronounced kapo.
I want to drink water, ngara ngai kapura ngultun.
Water, salt, kapu murnok ("o" very short)
Wattle tree, balara.
Wave (noun), buambang.

Wave, waves; big waves, breakers; torgo.
Wax, korng-gi (korqi).
Way (track), tokar.
Long way, barkwalla.
We two, ngali.
We three (or more), limuru.
Wet, mulkar.
Wet, jurro.
To get wet with drops from grass or trees, karra. (See Fog.)
Wet season, bara (Malay origin).
Wetnurse, to, ng-gongdo maranauwi (nqongdo).
Weep, ngarti.
Well again (after sickness), marana makurina.
Went to, tarara unuma.
Wessel Islands—
South Wessel Island, Rarakula.
North Wessel Island, Murtjenba.
Small island north of North Wessel Island, Walwal.
Whale, wimeri.
What, nar.
What is that? Nar du (or tu) wali?
What is this? Nar tu wala?
What is there? Nar nguna?
What is your name? Yuer ni yako?
What is his name? Yuer muka ni yako?
When, nata, natan.
When did Tom go away? Nata Tom maritjina?
When did you come across? Natan numa burapturana lurkon.
Where, anaka, nganaka, nganakana.
Where is Charlie? Nganakana Charlie?
White, wattarr ("r's" rolled).
White ant, minyukolungo.
White man, balanda.
White woman, nuna.
White froth all over sea as in a big storm, karrarameri (lit., all white).
Why, nganala, naltjara.
Who, yurlto.
Wicked, maremba.
Wide (as, wide table), belkbelk; goarlyindi.
Wild, wakingu.
Wild fellow walk about bush, yindipwi, wirdikno (or wurdikyun).
Will, bulu.
Willywagtail, jirabijirabi.
Wind, watta (wat-ta).
South or south-east wind, timoro.
West or north-west wind, bara.
North wind, long-guruma (lonquruma).
South wind, tong-gara (tonqara).
Windpipe, nerinnerin.
Wing, wings, bidenbur.
With child, kolun.
Big with child, kolun yuertomeri.
Woman (lubra), meal (me-al).
Old woman, karkarung.
White woman, nuna.
Wood, karndro.
Woomera, mangal (mang-al), bunbun.
To throw spear with, toptun.
Word, taro.
Work (verb), near at hand, jamauwa (ja-mau-wa); at a distance, jamaka (ja-mak-a).
Working, is, jamaka. Tommy is working for Bob Moy, Tommy jamaka Bob Moya.
Working, jama. Where are you working? Ngana ni jama?
World, wonga ngaraka (or wanga ngaraka). Wanga or warnga, camp.
Wound (hurt), kartpur.
Writing (noun), wokeri.

Y.

Yam, kang-guri (kanquri). At Karnapi this kind was found amongst the rocks on the slope of Point Bristow.
Another kind, muliangara. Has five-lobed leaf with serrated edge.
Year, tung-gara (tunqara).
One year, wang-gan (wanqan), tung-gara.
Two years, tung-gara bulul (bul-ul).
Yellow, kang-gul (kanqul).
Yes, yo, io. The latter, io, is the same as yes in Fijian. Sometimes owing to nasal pronunciation, ea.
Yesterday, bapuro.
Young men, yauwerin.
In Mau (Goulburn Islands), warion.
You, ni; nongo; niki; no kala; namalina.
Your, yours (singular), nungo. This flour is yours, Tuwala roti nungo; (plural) numalang-go (numalanqo).
You come with me, Ni rako malturo.
You sit down (singular), Ni nini; (plural, "big mob"), Nini numa.
You sit down in (one) line, (plural) Wangain nguru numa nini.

ADELAIDE, SOUTH AUSTRALIA: A STUDY IN HUMAN GEOGRAPHY.

By Charles Fenner, D.Sc.

[Read September 8, 1927.]

Contents.

I.—INTRODUCTION.

During the past twelve years the writer has been collecting material regarding the physiographical development of the Adelaide area. In 1924 he prepared a brief account of these features for publication in the Handbook of the Adelaide meeting of the Australasian Association for the Advancement of Science. As far as the physiography is concerned, the present paper is in part an elaboration of the general outlines there set down, with considerable extension and development of detail.

Throughout the paper attention is given to the influence of the geographic factors on the settlement, growth, and development of the city and surroundings. The economic aspect is emphasised, and the whole subject is dealt with from the points of view of cause, development, growth, and influence on human activity.

The science of human geography deals specifically with the present; in discussing causes and origins, there must, however, be continued consideration of both the geological and the historical past; while the ultimate value of the study lies in the richness of its suggestions regarding the possibilities of the future.

II.—SCOPE OF THE PAPER.

It will be necessary first to refer to the great structural unit of which the Adelaide region forms a part, and in this connection some peculiar characters of the so-called "Rift Valley" will be pointed out (figs. 1 and 2). The Adelaide Plains will then be considered in relation to the "Gulf Region" of the State (fig. 3).

The main body of the paper will be concerned with a discussion of the Adelaide area under the various divisions named below, which will be dealt with broadly, keeping in view the human influences of the various physiographic and climatic factors. These divisions have been set down as follows:—

(a) The Adelaide Plains;
(b) The Mount Lofty Ranges;
(c) The Torrens and its estuary;
(d) The tributaries and associated streams.

The general climatic conditions will be summarized, and note made of the modes of transport, communications, and occupations. Finally, the growth

and distribution of the present population of the Adelaide area will be considered in conjunction with a "spot map" of the city and suburbs.

Tribute must be paid to the geological and physiographic work bearing on this area published by Howchin, Mawson, Benson, Teale, and others; to the numerous Mines Department maps, and publications by Brown, Ward, and Jack; and to historical accounts by Blacket, Gill, Grenfell Price, and the numerous writers of the first decade of South Australian history. The work of Professor Howchin on the geology and physiography of this area has extended over almost fifty years, his first geological paper having been published in 1886.(1) For most of the fundamental geological knowledge that underlies this paper, much of which is implied rather than expressed, acknowledgment must be made of indebtedness to the work done in this area by Professor Howchin and Mr. H. Y. L. Brown. The writer is also greatly indebted for advice and information, readily given, by Sir Douglas Mawson and Dr. Keith Ward. This paper is an effort to correlate many facts already known, to add the writer's own observations and conclusions, collected during the past ten years, and to present a concise account of the human geography of this important area.

III.—SPECIAL CHARACTERS OF THE "RIFT VALLEY."

In order to deal more fully with the structural features of the Adelaide area, it is necessary first to describe the great central structural unit of the State, of which the Adelaide area forms a small part. The unit in question is the one which has come to be known as the "Great Rift Valley of South Australia," with its associated highlands (*vide* "The Dead Heart of Australia," J. W. Gregory, 1906, pp. 236-245).

The conception of this axial area as a rift valley, which we owe to Professor J. W. Gregory, has greatly simplified geological and geographical descriptions of the State, and has added enormously to our understanding of many of its problems. It may be pointed out, however, that this so-called rift valley has many peculiar characters—characters which are not usually associated with a rift valley proper.

For instance, a "rift" as generally described implies a let-down block of country, longer than it is wide, with relatively uplifted highland areas on either side, and with bounding faults that are more or less parallel. In the area under discussion we have to deal with something quite different, as will be realised from a description of figs. 1 and 2.

Fig. 1 shows the Lake Torrens—Spencer Gulf—Gulf St. Vincent area, with geological and topographical data taken from the S.A. Mines Department's geological and contour maps. Geologically, the horizontally shaded areas consist of Palaeozoic and older rocks, while the unshaded land areas represent Tertiary and Recent deposits. Some Cretaceous rocks occur in the north, and also a small let-down pocket of Triassic coal-bearing rocks at Copley (Leigh's Creek), but these do not affect the discussion. The broken line is the approximate 500-foot contour line.

It will be noted that most of the Tertiary area consists of low plain, almost level, and that the greater part of the higher land is Cambrian and Pre-Cambrian. Actually the 500-foot contour line so nearly coincides with the boundary line between the Tertiary exposures and the Palaeozoic outcrops that for our purposes they may be considered the same. We may,

(1) Professor Walter Howchin arrived in South Australia in 1881. During his first six months' residence he contributed to the daily Press several leading articles on "The Geological Survey of South Australia"; shortly afterwards a Mines Department was established and a Government Geologist appointed. The paper above referred to was entitled, "Remarks on a Geological Section at the New Graving Dock, Glanville," Trans. Roy. Soc. S. Austr., vol. x., Dec., 1886, p. 31.

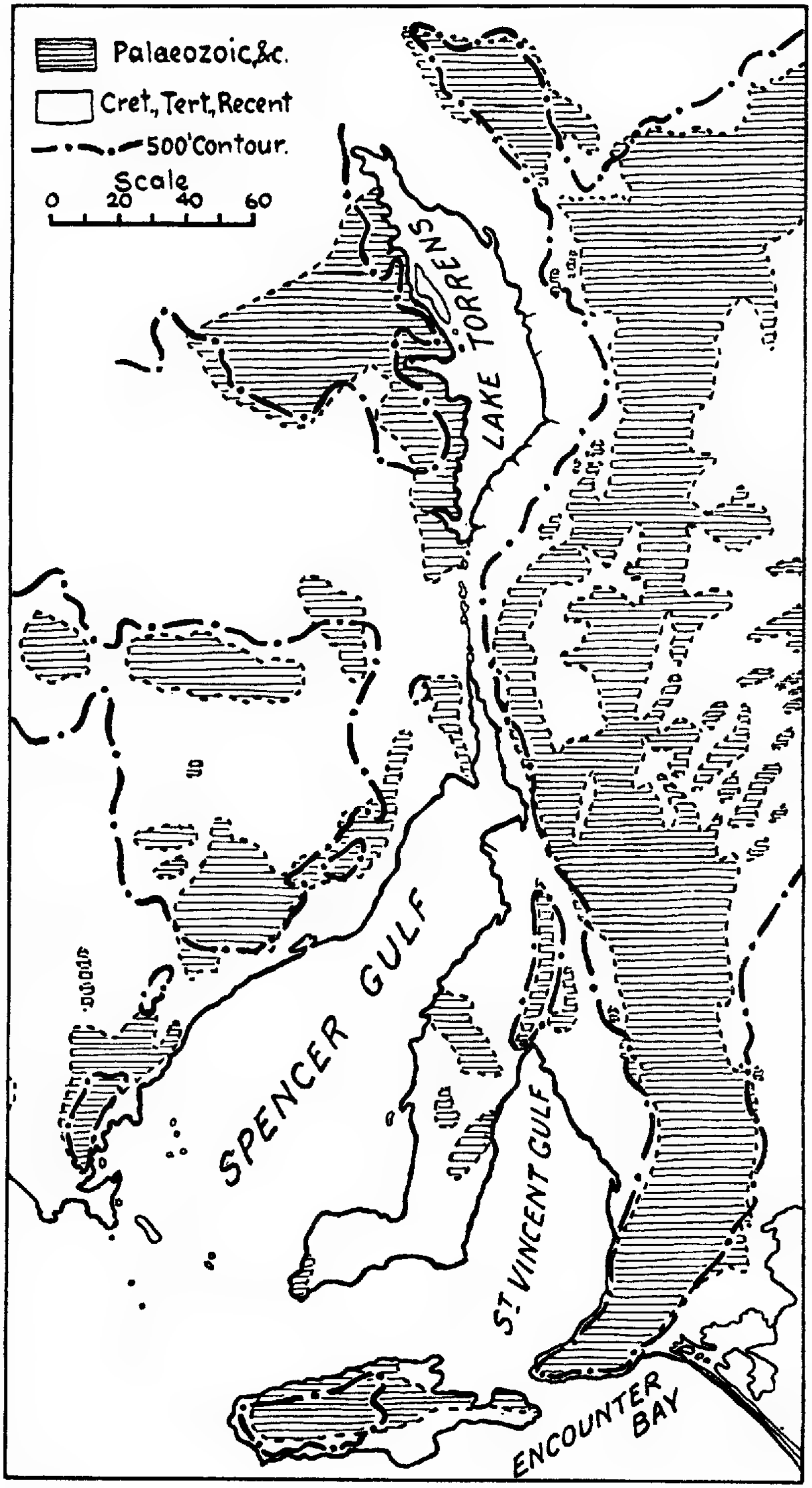


Fig. 1.
The area of the South Australian "Rift Valley," showing the essential features of the geology and topography, as described in the context.

therefore, speak of *(i.)* The Highlands of Palaeozoic rocks, *(ii.)* The Plains of Tertiary rocks.

In the western half of the area shown in fig. 1 we have a broad platform of Palaeozoic and older rocks, really a portion of the great relatively stable Pre-Cambrian Foreland—the Continental Shield that extends for many hundreds of miles to the north-west and west. In the central zone we have the sunken areas of Lake Torrens, Spencer Gulf, and Gulf St. Vincent, with associated alluvial plains.

In the east we have a huge double arc of highlands of Palaeozoic rocks, shaped like an open "3", the bottom portion being much the larger and containing within its curve the secondary and lower highland of Yorke Peninsula. Within this highland area there are many elongated alluvial tracts, particularly in the "Lower and Middle North," parallel to the course of the mountains, of high economic value, constituting some of the best agricultural areas of the State. In the south, towards Investigator Strait, there are several patches of Tertiary deposits, roughly triangular, occupying let-down areas on the tilted fault blocks; the Copley Triassic is a similar triangular let-down block in the north (see Brown's 1899 map). This great highland belt of Cambrian and Pre-Cambrian rocks has long been recognised as a very definite horst, of about Pleistocene age (the Kosciusko uplift).

The "Rift Valley" is seen, therefore, to be of a quite unusual and irregular shape. This is resolved into its simplest aspect in fig. 2. The relatively raised and sunken blocks and the chief boundary fault lines are clearly defined. Concerning these, the physiographic evidence alone is sufficient demonstration of their existence, and this is supported in every way by the geological evidence, as already shown in fig. 1. Names are given to these features as follows (see fig. 2) :—

The western boundary faults—The Torrens Fault, the Lincoln Fault.
The eastern marginal highlands—The Flinders Horst, the Mount Lofty Horst.
The central lower tongue—The Yorke Peninsula Horst.

It will be seen that within these highlands the "Rift Valley" really consists of two semi-circular sunken areas such as are termed sunklands. In the southern sunkland, the Yorke Peninsula block is simply one of the sunken segments, relatively less depressed than its neighbours; its existence does not destroy the essential unity of the southern semi-circular sunkland. The two sunklands are connected by the narrow "Port Augusta Corridor."

For purposes of definiteness in discussion these two great half-moon depressions have been called "The Torrens Sunkland" and "The Spencer-Vincent Sunkland." In the east of the area described there are two highland "spurs" (distinct in their structural characters from the main horsts) which curve away to the north-east from the Flinders and Mount Lofty Horsts. They may be called the Yudnamutana Spur and the Olary Spur, respectively; the latter is much the lower and carries the Peterborough-Broken Hill railway line.

The Torrens Sunkland does not come any further into the present discussion, and the Spencer-Vincent Sunkland is dealt with in greater detail in the section dealing with the Gulf Region. With reference to these peculiar structural features—bounded on the west by a straight-cut fault along a relatively stable foreland, and having a down-warped or step-faulted sunkland of semi-circular shape, margined to the east by an arcuate horst—it is suggested that they constitute structural units of somewhat common occurrence, and possibly worthy of a distinctive name.

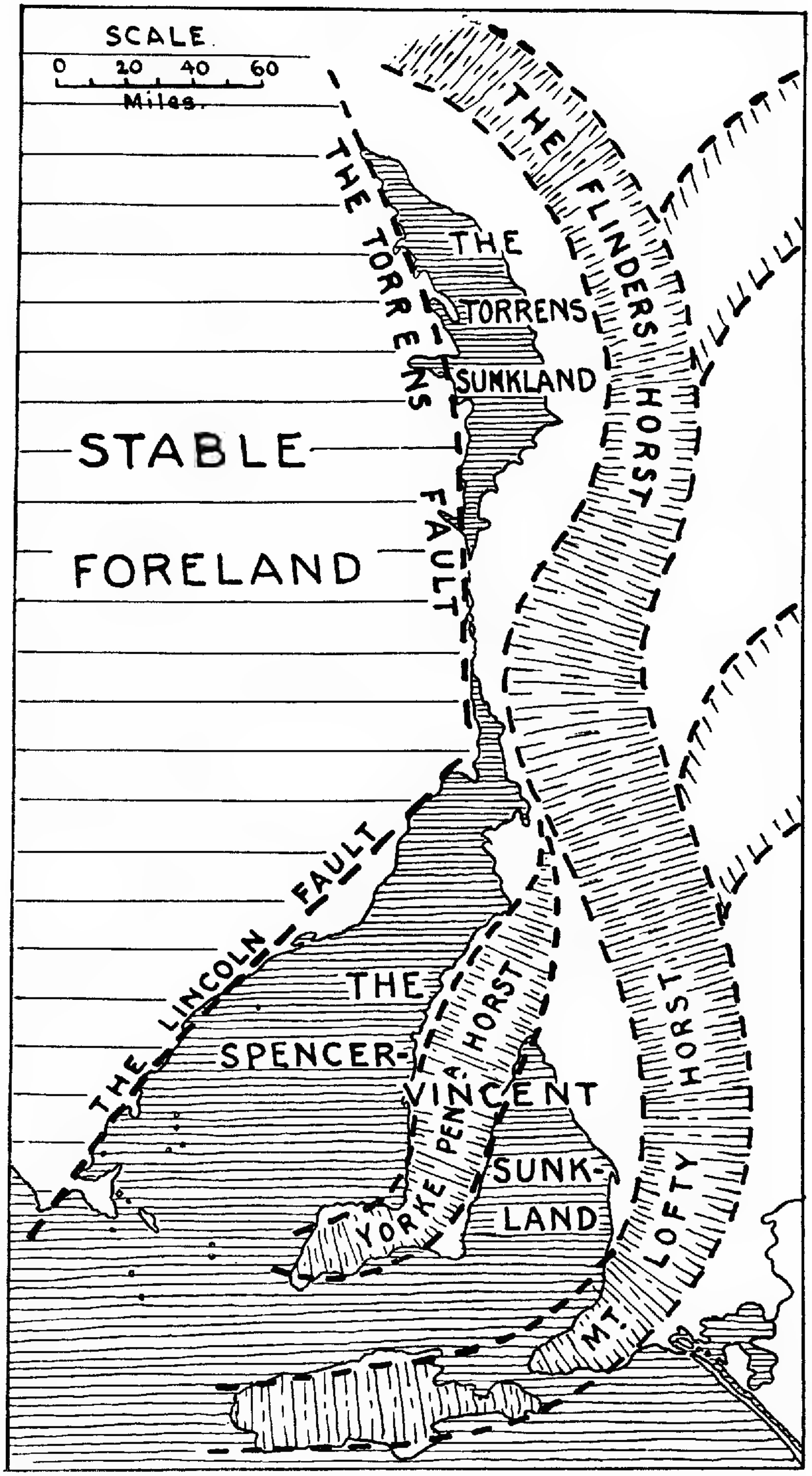


Fig. 2.
The same area as fig. 1, showing the chief structural features in broad outline.

Taylor has described such a feature in Lake George and the Cullarin Fault in New South Wales (ref. 18). The writer's own observations of the Victorian Grampians lead him to believe that similar structures control the physiography of these interesting ranges. It may further be suggested that the great highland arc of the East-Australian Cordilleras, with its included tectonic basins, and the stable foreland of the western half of the continent, constitute a somewhat similar feature on an enormous scale.

This in turn gives rise to the idea—since there is a general agreement that all these features are closely associated in time—that there is a genetic connection between them. Possibly they are related to outward (tensile) crustal movements from the stable Westralian "Shield" towards the founderings of the continental margin in the Coral and Tasman Seas to the east, in Upper Tertiary time.

IV.—THE GULF REGION.

The Gulf Region of South Australia is not a "natural region" in the geographic sense, but comprises portions of several geologically and climatically distinct types of country. Although the physiographic features are also of very varied characters, it has been suggested in the previous section that the greater portion constitutes a physiographic unit—the "Spencer-Vincent Sunkland." This suggestion will be further elaborated here.

The Gulf Region is, moreover, the heart of the State of South Australia—its most varied and most fertile area. Although comprising little more than 5% of the total land area of the State, it is at present the home of nearly 90% of the population (see fig. 15).

As will be seen from fig. 3, the area may be broadly simplified into three southward-pointing peninsulas and three northward-pointing gulfs. We shall first briefly describe these, geologically and physiographically, and then emphasise the tectonic unity of structure of the whole of the Gulf Region.

(a) *Eyre Peninsula.*—This is included in part only. The peninsula is broad-based to the north, and triangular in shape, with an irregular coastline and many off-shore islands; it is of low relief, mostly less than 500 feet, but rising in places to just over 1,000 feet; streams are rare; geologically it is very ancient (a Pre-cambrian complex), usually regarded as part of the great Continental Shield—the Foreland—that dominates the western half of Australia. Though relatively stable, the eastern portion of Eyre Peninsula has undergone considerable fracturing in past ages. The overlying Tertiary and recent deposits are thin and of varied character. The vegetation is mostly "Mallee"—scrub eucalypts and acacias, with casuarinas, banksias, and associated undergrowth; it is developing as a wheat-growing area. The great mineral masses of Iron Knob and Iron Monarch occur here. The rainfall varies from 25 inches in the south to 10 inches in the north. The geological and physiographic facts provide evidence of the existence of a great N.E.-S.W. fault roughly parallel with the Port Lincoln-Whyalla coast, and a little way inland (F.)—the "Lincoln Fault" (fig. 3).

(b) *Yorke Peninsula.*—An almost parallel-sided peninsula, roughly leg-and-foot shaped. For the most part it has a very regular coastline, with but few indentations or islets. It is of low and even relief, the highest point being a gentle rise little more than 400 feet above sea-level. The area is practically streamless, and of uniform character. The foundation is of Pre-Cambrian, Cambrian, later Palaeozoic, and Plutonic rocks—highly resistant to weathering. The peneplaned surface of these ancient rocks is now covered by a relatively thin sheet of Tertiary limestones and gravels, with recent travertines; the surface is thus a young and almost undissected plain of deposition. There is no notable physiographic evidence of later Tertiary faulting within the peninsula itself, but the whole block consists of an irregular-shaped horst, its

probable relations to the Mount Lofty arc of uplift having already been discussed. The vegetation was of uniform mallee type; this has almost wholly disappeared, to be replaced by wheat fields and grazing lands. In the north, rich copper deposits were mined for sixty years; the poorer lands of the south are valuable for the output from their salt and gypsum lakes. The rainfall is very even—15 to 20 inches over the whole peninsula.

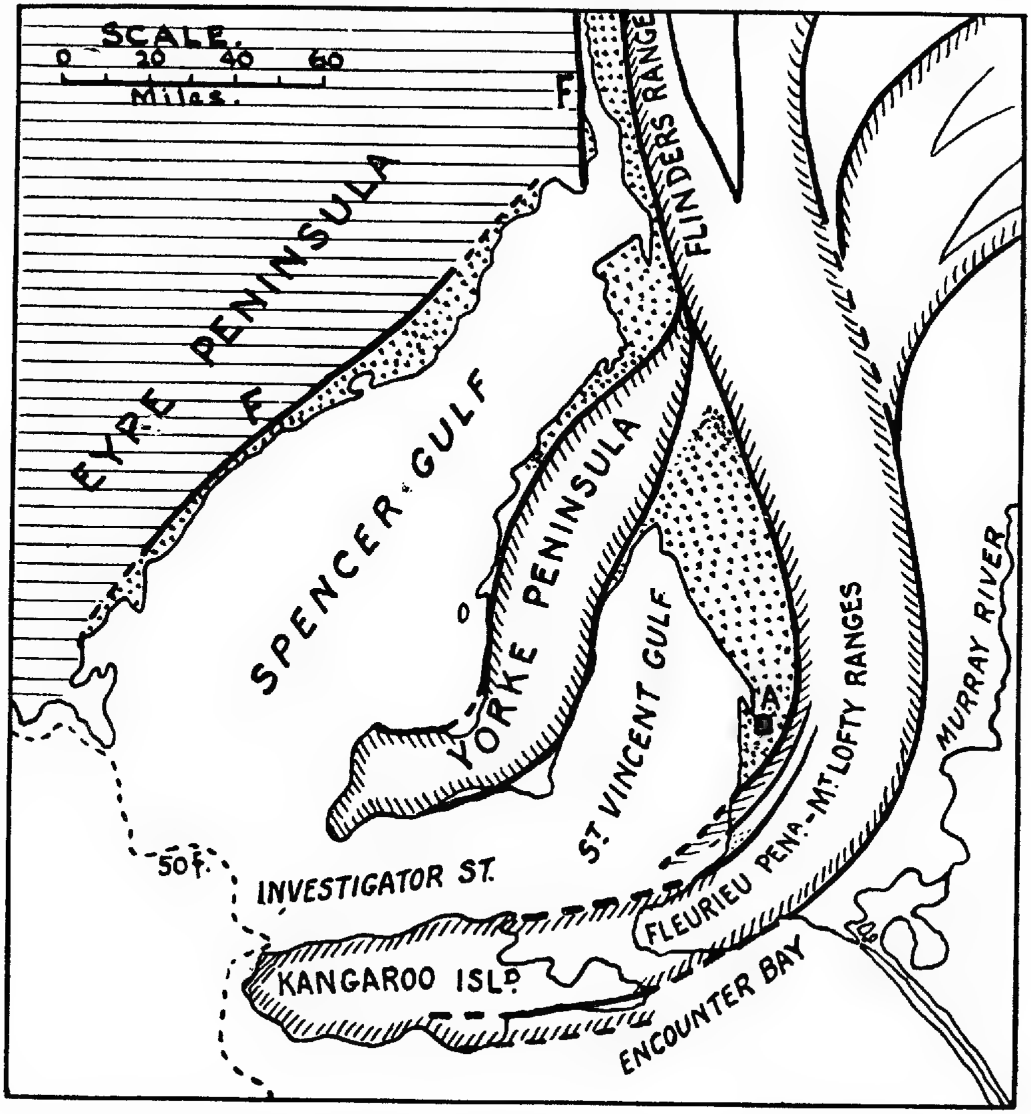


Fig. 3.

Plan showing the main geographical and structural features of the "Gulf Region." The site of Adelaide is indicated by the letter A. The dotted portions are alluvial plains within the sunkland.

(c) *Fleurieu Peninsula.*—This is best considered in connection with its northern continuation, the Mount Lofty Ranges, and its southern extension, Kangaroo Island. Thus we have a curved westward-pointing peninsula—the southern-most limit of the great arcuate horst shown in fig. 3. This peninsula is economically the most important portion of South Australia. It is of highly

varied relief—level plains, high scarp faces, broad valleys, and deep gorges—the highest point reaching 2,334 feet. Geologically it consists of the same materials as Yorke Peninsula, but in the highlands the very resistant Pre-Cambrian and Palaeozoic rocks are generally exposed, the less resistant over-mass of Tertiary limestones having been almost completely stripped off (as later described in detail).

The physiographic structure is varied, and is dominated by a series of curving faults. Backstairs Passage is probably due to a sunkland between radial faults, though Benson has suggested marine erosion in softer Permo-carboniferous rocks (ref. 1). The site of Adelaide is on the alluvial plains that lie within the curve of the Mount Lofty Horst (see A, fig. 3). The physiographic, geological, and climatic variety of this area is reflected in the vegetation, minerals, and general products. The native vegetation is of the mallee and callitris suites on the plains, with salt-bush in the more arid north-eastern parts, and eucalyptus forest on the highlands, where *Eucalyptus elaeophora, obliqua*, and *rostrata* are dominant. Gold, silver-lead, and copper have been mined in various areas; building stones, slates, clays, and cements are produced. Orchards and gardens flourish in the highland valleys; vines, olives, stone-fruits, oranges, etc., in the lower valleys and on the plains. The rainfall varies from 15 to 47 inches, as later described in detail.

(d) *Spencer Gulf.*—A long, acutely terminated gulf, penetrating the continent for 200 miles. It is shallow and shoaled, with a maximum depth of less than 40 fathoms at its wide island-studded mouth, and averaging less than 20 fathoms throughout. The boundaries, except where modified by delta accumulations, are controlled by faults. Port Lincoln, an inlet near the mouth of this gulf, was a keen competitor for the site of the capital of the State, but was rejected by Colonel Light for reasons given in detail on pages 31-33 of his "Journal," and elsewhere. Several important ports are situated in this gulf, including Port Pirie, Wallaroo, and Port Lincoln.

(e) *Gulf St. Vincent.*—This gulf is considered in conjunction with its natural approach, Investigator Strait. The two bodies of water together form a broad, shallow, boomerang-shaped inlet. Although 40 fathoms deep at the entrance, it is rarely more than 20 fathoms elsewhere, and averages 16 fathoms or less. It is shallower towards the west than towards the east. The coasts are precipitous where they meet the resistant highland mass, on the south and south-east, from Marino to Cape Jervis and on Kangaroo Island. There are low cliffs also on the up-tilted eastern face of Yorke Peninsula; elsewhere the coast is very low, with mangrove swamps and mud flats or sand dunes. The outlines are tectonic, modified by deltaic accumulations on the east, and by some amount of marine erosion.

In the northern extremity there is excellent evidence of a recent marine recession of several miles (an area that was made the subject of an interesting botanical survey by Osborn and Wood, Proc. Roy. Soc. S. Austr., vol. XLVII., p. 244). For reasons given in his "Journal," Colonel Light early decided that the most advantageous place for a settlement in South Australia was upon this gulf, on its eastern shores—a decision confirmed by his belief (unfortunately erroneous) that it afforded easy communication with the Murray Valley. Doubtless Light was influenced in his decision by Sturt's accounts. This gulf is not so well provided with ports as is its western neighbour; the single suitable site for an important port is on the Port River Estuary. On the western side, where the gulf is more shallow throughout, there are several small ports, chief of which are Edithburgh and Ardrossan.

(f) *Encounter Bay.*—A blunt, widely-open bay, to be considered in conjunction with its one-time northward extension—now the lacustrine and deltaic area of the Murray Mouth. This bay was uppermost in the

thoughts of many of the founders and pioneers of South Australia as the most suitable locality for the future capital. Since the stimulus of Sturt's Murray River journey of 1831 had so much to do with the founding of South Australia, and as the minds of the founders turned so strongly to the Murray Basin this can be readily understood. With that remarkable "topographical instinct" with which Light has been credited, he was able to sum up in a few phrases his reasons against an Encounter Bay site, these reasons being supported by his belief that the southern Adelaide Plains were provided with easy access to the Murray Basin.

It is urged to-day, with much logic, that the capital city of South Australia should have been placed at the mouth of the Murray Valley. That is to say, it should be in the region of Encounter Bay. We must remember, however, that Light had to find a harbour where safe and immediate anchorage could be found for the many immigrant ships that were following so closely on his heels. In his "Journal" he wrote under date December 17, 1836 (pp. 36-37): "As much as Encounter Bay and Lake Alexandrina had been talked of in England, I never could fancy for one moment that any navigable entrance from the sea into the lake could possibly exist. On looking at Flinders' chart, and considering the exposed situation of the coast, open to the whole Southern Ocean, great danger must always attend the approaching it with fresh breezes; moreover, the very circumstance of so large a lake being there was a convincing proof to me that the Murray could not have a passage sufficiently deep or wide to discharge its waters into the sea. These ideas I mentioned in England, and often during our passage, but when I saw the sandy shore to the eastward of Encounter Bay from the "Rapid" as we stood over, beating against strong northerly winds, and seeing that this shore of sand was open to several thousand miles of the Southern Ocean, where south-west winds prevailed during eight or nine months of the year, I was more than before convinced that no good and accessible harbour could exist, contrary to the general laws of nature. Deep and fine harbours, with good entrances on the sea coast, are only found where the shore is high, hard, or rocky; in other cases such harbours must be in large rivers or gulfs; sand alone can never preserve a clear channel against the scud of the sea, and particularly such as must inevitably be thrown on the coast about Encounter Bay." This point is dealt with at some length, for geographically the one flaw that has been revealed by ninety years' experience of the site of Adelaide is the barrier that exists between that city and the Murray Basin, and the geographical necessity for a deep-water Murray port.

(g) *Tectonic Unity of Structure of the Gulf Region.*—In a paper previously referred to (ref. 8) the writer described "the great arcuate horst of the Mount Lofty Ranges, with its shadow or echo in the less elevated and less regular arc of the Yorke Peninsula Horst nestling within it." This description emphasised the need for an explanation of these relations from the genetic point of view. Such an explanation has been attempted in the previous section.

The connection between the northern end of the Yorke Peninsula Horst and the main Mount Lofty Horst is somewhat obscure, and will probably remain so until more detailed geological and contour maps are available. West of Port Wakefield the eastern margin of the Yorke Peninsula Horst appears as a low but very definite fault scarp; this rises suddenly into the Hummocks Range, and continues northward as the Barunga Ranges. The available evidence, plus personal observations in the field, suggest that the broad block of the peninsula tapers towards the north, possibly due to plunging, and the faults of the eastern and the western margin appear to unite and to meet tangentially with the western faults of the main horst in the Red Hill-Crystal Brook area.

It may happen in block-faulted areas, as pointed out in Section III., that a depressed block is sharply faulted down along one straight marginal face, but step-faulted or warped down on all the other sides, within a semi-circular area, the main displacement fading out laterally and the whole feature forming as it were an inverted semi-dome. Thus we get a "D-shaped sunkland," as already described and figured.

In the "Gulf Region" we have as the north-western straight-edge boundary the Lincoln Fault; the semi-circular eastern boundary is the horst of the Mount Lofty Ranges and Kangaroo Island, broken to the south-west by the tectonic movements associated with the foundering of the Jeffrey Deep. Within the semi-circle we have a series of depressed blocks, more or less concentric, with one segment uplifted relatively to its neighbours, giving the Yorke Peninsula Horst. Thus we have a close genetic relationship between the varied features of the whole of the "Gulf Region," constituting the Spencer-Vincent Sunkland, with its associated highlands.

V.—THE ADELAIDE PLAINS.

The site of the city of Adelaide is in the apex of the triangular area of alluvial plains that lie within the curve of the Mount Lofty Ranges, bounded on the west by the eastern shores of Gulf St. Vincent (see fig. 3). The four natural divisions involved are The Gulf, The Plains, the Highlands, and The Streams. Fig. 4 has been drawn to show the Adelaide Plains. This area will be discussed under the following headings: (a) The coastline; (b) The outer sand dunes; (c) The lower deltaic plain; (d) The older sand dunes; (e) The higher deltaic plain; (f) The Para fault block; (g) Factors determining the city site; (h) Factors influencing the plan of the city; (i) The rocks of the Adelaide Plains.

(a) *The Coastline.*—Gulf St. Vincent has already been described in some detail. The chief features that concern us here are the eastern shores, from the mouth of the Gawler River south towards Cape Jervis. This coast comprises two types:—

(i.) Low coasts with sand dunes to the north.
(ii.) Precipitous rocky coasts to the south.

The division between the two types comes at the appropriately-named suburb, Seacliff, where the Mount Lofty Ranges are obliquely truncated by the coastline. Northward of this point the coast of Gulf St. Vincent is low, with ridges of sand dunes, occasional sand-barred stream mouths, muddy mangrove flats, and the notable and important major break of the Port River Estuary.

The shape of the coastline is at first sight somewhat puzzling, inasmuch as the alluvial deposits west of Adelaide do not extend as far west as one would at first expect. The whole area of Gulf St. Vincent has already been described as a down-faulted, boomerang-shaped segment, doubtless a series of blocks (a compound sunkland). This assumes the eastern shore, like the western, to have been to some extent determined by fault boundaries, and such evidence from the floor of the gulf as is provided by the data given in the Admiralty Charts is in support of this. The difficulty is that, if the present trend of this eastern coast to Cape Jervis has been determined by a fault, this fault does not run concentrically with its better known neighbour faults in the highlands, but cuts obliquely across them.

Important evidence is provided by the fine series of truncated spurs, of great scenic beauty, that occur from Carrickalinga Head southward. Supporting evidence of a minor but suggestive character is provided by a small fault (parallel to the present coast) that forms the eastern boundary of the

let-down Permo-carboniferous and Tertiary rocks of Hallett's Cove. The close resemblance of the general coastline features to those of faulted coasts in New Zealand, as described by Cotton ("Fault Coasts in New Zealand," Geographical Review, vol. I., No. 1), suggest:—

(i.) That this cliff-bound coast has been determined by a fault-line;

(ii.) That the fault was somewhat subsequent in time to the main Mount Lofty Faults;

(iii.) That it may be in part the southerly continuation of what is called in this paper the Para Fault.

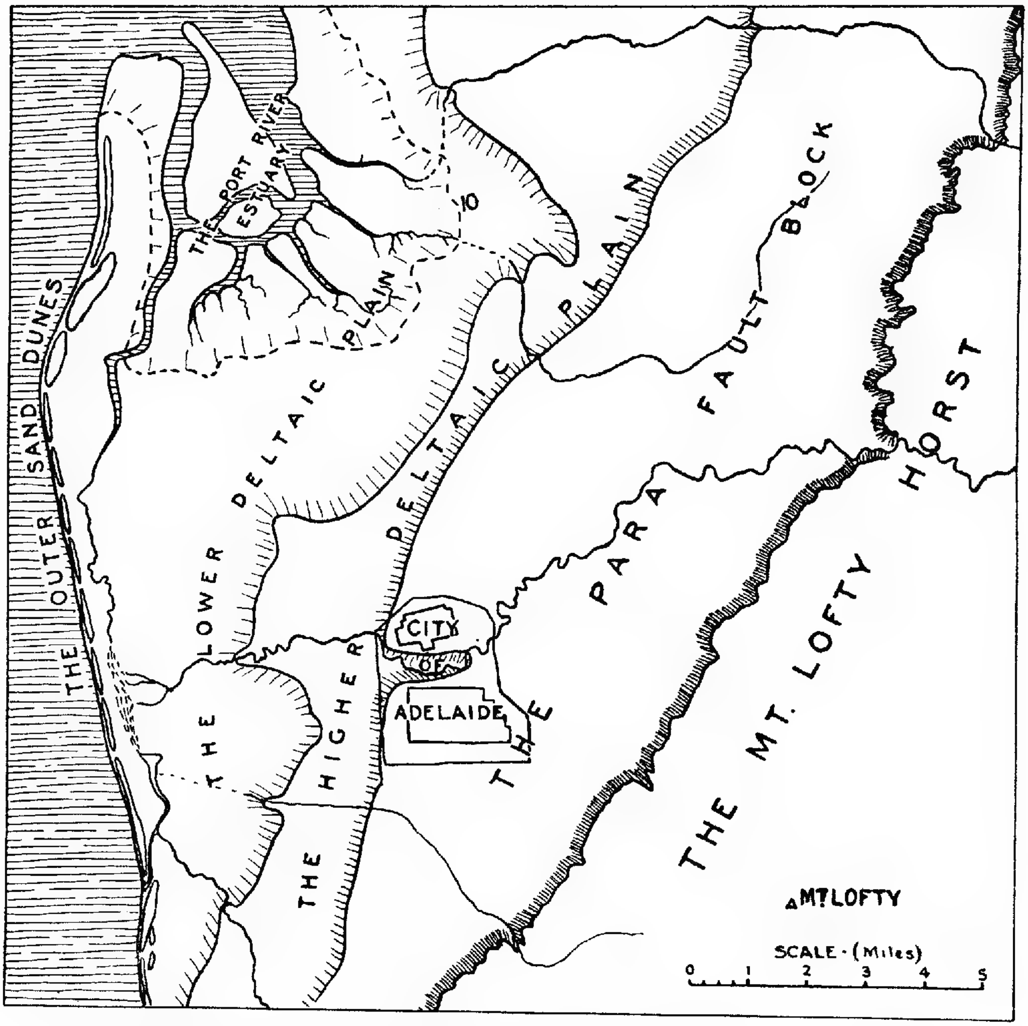


Fig. 4.

Plan of the Adelaide Plains showing the physiographic zones, as described in Section V. The site of the city proper is indicated on the plan. The boundaries between the various zones are determined by differences of both elevation and geological structure.

This southern precipitous, wave-cut, upward-faulted coast of highly-resistant, silicified sediments, etc., from Seacliff to Cape Jervis, provides a few small gently-curving bays, such as Rapid Bay, Yankalilla Bay, and others,

and these were carefully explored in 1836. As would be expected from such a physiographic history, there is reasonably deep water close inshore in many places; but there are no real inlets. The coast is exposed to the full force of the western seas, and the fault-truncated spurs have suffered considerable marine erosion. There are some fine wave-cut platforms, as at Hallett's Cove. A site on this coast (Marino) was, in the early 1900's, the chief competitor with the present Outer Harbour site.

Almost equally unpromising from the point of view of harbour facilities is the rising coastline of low alluvial that lies to the north of Seacliff. The only chance for a harbour, therefore, is a protected estuary. Fortunately, the discovery of the Port River Estuary by Collet Barker (ref. 15), and its rediscovery and description by Captain Jones in 1833 (see Proc. Roy. Geog. Soc. S. Austr., vol. XXII., 1923, p. 73), plus the subsequent persistent and successful quest of Light for this harbour in 1836, gave to us the two chief harbours of the State which, together, constitute the fourth port of the Commonwealth.

After a preliminary use of Holdfast Bay (which is practically open sea), the Port River (at the so-called "Port Misery," and elsewhere) functioned as the main port of the Province. The present inner harbour, in the Port River, was declared "open to the world's shipping" by Governor Gawler in 1840. The Outer Harbour, built on the southward curving continuation of the Port River, discovered in 1836 and known as Light's Passage, was similarly declared open to the world's shipping in January, 1908. The same underwater features, namely, Light's Passage and the curiously-shaped shoal bordering its mouth on the east (see fig. 11), that have been utilised for the building of the Outer Harbour, were the locus of an ambitious scheme for an Ocean Dock presented to Parliament by George Chamier, C.E., as far back as 1882.

It is interesting to note that in the report of Sir George Buchanan, K.C.I.E., to the Commonwealth Government, dated October 9, 1926, he suggests that the whole of the northern end of LeFevre's Peninsula, from the present Outer Harbour round to the sites of the Electric Supply Co.'s Works, should be made a line of wharves, with the implied ultimate linking up of the outer and inner harbours as one continuous system.

Such a broadly conceived scheme would mean the utilisation to a high degree of the natural facilities that are provided by "Jones' Harbour" and "Light's Passage." Sir George Buchanan remarks on the "immense stretches of water available for deep water wharves," and adds: "Very few ports are so admirably situated as Port Adelaide for development at moderate capital cost. The river apparently can be dredged to any depth, and so far as I can judge from the information available, there will be practically no maintenance dredging." The detailed physiography of the estuary is further described in Section VII.

(b) *The Outer Sand Dunes.*—From Seacliff and Brighton, through Glenelg, Henley, Grange, Semaphore, and Largs to Outer Harbour, and again to the north of the estuary, there is an almost continuous ridge of sand dunes (see fig. 4). Apart from the break where the Patawalonga enters at Glenelg, these dunes are remarkably regular and even—about 10 chains in width, nearly 20 miles in total length, and averaging 30 to 40 feet in height.

The highest dunes (50 feet) are at Brighton and at a point north of Estcourt House. Where the dunes have not been interfered with by settlement, they usually show three more-or-less well-defined parallel ridges. They flatten out to the north of Semaphore and Largs, and help in forming the flat, square-nosed area known as LeFevre's Peninsula. At Semaphore, the coastline bulges out to the west, forming Point Malcolm and giving rise to the

Wonga Shoal. Under the influence of the prevailing south and south-west winds and associated currents, this long sand spit has been slowly built up from Seacliff northward. The building of this dune barrier was one of the most important factors in the growth and development of the lower Adelaide Plains.

The northern portion of LeFevre's Peninsula, from Largs onward, was for many years a despised and neglected locality, and is still largely waste land. It needs no special gift of prophecy to foresee that the natural geographical advantages of this area will be more fully utilised in the future, and that this peninsula must play an important part in the development of the city and the State. The western (sand dune) portion is the higher; on the east there are extensive samphire swamps.

The outer sand dune belt has greatly influenced settlement, as may be noted from the long line of seaside suburbs listed above; the linear extension of many of these suburbs is most marked (see fig. 4), particularly where landward extension from the dune area is prevented by the swampy, low-lying areas of the lower deltaic plain. The dune belt, as befits our Mediterranean climate, bids fair to present, in due course, one continuous line of seaside residential suburbs and pleasure resorts from Seacliff to Outer Harbour. There are excellent beaches, that are greatly appreciated despite the drawbacks of western aspect and lack of shade. With the population and climatic conditions of Adelaide, it is natural that this outer sand dune belt should be made the subject of a comprehensive foreshore-improvement scheme.

(c) *The Lower Deltaic Plain.*—This area may be defined as that lying between sea level and the 40-foot contour line—the latter line being arbitrarily chosen as a convenient boundary. The whole of the Adelaide Plains is deltaic in origin. There is abundant evidence of the eastward extension of the sea in recent times *(vide* "Notes on a Recurrent Transgression of the sea at Dry Creek," W. Howchin, Proc. Roy. Soc. S. Austr., vol. 36, 1912, p. 34), and of oscillations in the relation of sea and land. Meanwhile the Torrens and associated streams have gone on depositing their abundant sands, silts, and muds, so that there is now an enormous accumulated thickness of these delta-building deposits.

Some portions of the lower deltaic plain are now high and dry, as in the growing suburban areas of Woodville and West Torrens. In other places building has gone on in the face of much difficulty and inconvenience, as at Port Adelaide and suburbs, and in the more easterly suburbs of Glenelg. While flat mud banks, close to sea level, are not promising sites, it must be remembered that great sea ports, such as Amsterdam and Venice, have been built in such areas.

There is a belt of country, one to two miles wide, running northward from between Glenelg and Morphettville through the Reedbeds to Port Adelaide. This is liable to winter floods, is mainly an area of considerable fertility, and must remain sparsely settled, mostly used for grazing, for many years. These are the "Cowandilla Plains" of the early settlers; they constitute a feature of what is called the "Floodwaters Problem," and their special geographic characters are further dealt with in Section VII.

Finally, there is the portion of the deltaic plain that is below the 10-foot contour line, mainly muddy mangrove flats surrounded by embankments —an area that is at present neither sea nor land; this is also dealt with in some detail in Section VII. The lower deltaic plains contain our chief port and most of the important manufacturing suburbs, as well as large areas of orchard cultivation and grazing lands. Here, also, is the site of an important aerodrome, and of many sports grounds.

One of the more valuable positions for city growth within the sand-dune and lower delta areas appears to be the northern portion of LeFevre's Peninsula, where zoned extensions are now slowly proceeding northwards towards Outer Harbour—factory sites along the river front, residential suburbs along the seaward front on the west, and potential wharfage and railway areas around the northern end.

(d) *The Older Sand Dunes.*—Naturally, there was more than one belt of coastal dunes formed during the westward and north-westward extension of the Adelaide Plains. Such features are mostly transitory, and few traces of them remain. There is, however, one belt of old sand dunes that should be mentioned, since it evidently marks a physiographic feature that existed for a considerable period of time. This belt of old dunes is of some economic significance, in that they provide garden sand, building sand, etc., and also because they provide dry and varied areas on the otherwise swampy plain. Because of their reddish colour, they are very noticeable features of the delta plains as viewed from the hills. Where they occur in the lower parts of the deltaic plain, the raised, dry areas are suitable for settlement and are so used in places.

These dunes are up to 50 feet in height, but have been for the most part levelled down. In no less than three localities—Seaton, Glenelg, and Kooyonga—they have provided sites for golf-links. The dune belt is irregular and discontinuous. It extends from the east of Glenelg, roughly parallel to the coast, northward to Port Adelaide, and possibly forms the higher western portion of Torrens Island; it is about 1½ to 2 miles back from the present coastline, and may mark the last lengthy period of still-stand of the shoreline.

(e) *The Higher Deltaic Plain.*—This is defined as the area between the 40-foot contour line and the 100-foot contour line (*vide* contour plans, vertical interval two feet, of the Hydraulic Survey, and the Commonwealth Military Contour Sheet of Adelaide). It is really the older, and therefore the higher-level portion of the plain eastward of the "lower deltaic plains" above described, and running up to the Para Fault Scarp (see fig. 4).

Since the Para Scarp disappears to the south of Adelaide, the 100-foot contour line may there be taken to provide a suitable boundary. The building up of the deltaic plains has been the work of at least three agencies:—

(i.) The rising coastline;
(ii.) The accumulation of river-borne deposits; and
(iii.) The building up of sand-dune deposits under the influence of the prevailing southerly and south-westerly winds and tidal sweep.

The higher deltaic plain really consists of widespread fan-deltas extending outwards from the mouths of the streams, where they emerge from the higher fault-block adjoining to the east (see fig. 4). The chief of these fan-deltas, clearly to be seen on the contour maps referred to, are of (a) Little Para River (to the north of the area here described, but shown in fig. 4); (b) Dry Creek; (c) Torrens River, economically the most important; and (d) the less well-defined fan-deltas of Brownhill Creek and Sturt River.

Each of these fan-delta areas is economically important. The Little Para Fan provides the site for the village of Salisbury, and its fertile surroundings; the Dry Creek Fan is mainly occupied by the Municipal Abattoirs and associated settlements. On the Torrens Fan are the important and thickly-settled suburbs of Hilton, Mile End, Thebarton, Hindmarsh, Bowden, Croydon, and Kilkenny. On the area farther to the south we have the residential and manufacturing areas of Richmond, Plympton, and Edwardstown, and the beautiful vine and orchard districts of Marion.

(f) *The Para Fault Block.*—This is the third and the most important zone of the Adelaide Plains proper. It comprises a broad belt of country sloping southward from the Para Hills (north-east of Adelaide), gradually becoming lower until, to the south of the Torrens River, this block of ground merges into the general levels of the plain (see geological sections, fig. 7).

For purposes of definition it may be regarded as that area within the 100-foot and the 500-foot contours (see fig. 4). It must be remembered, however, that the 500-foot contour line, which bounds the foot of the main Mount Lofty Scarp from the opening of the Torrens Gorge to that of the Brownhill Creek (10 miles), bends outward from the foot of the range where it passes to the north of the Torrens Gorge, and extends into the range to the south of Brownhill Creek. North of the Torrens Gorge, to the Little Para River, the 1,000-foot contour marks the eastward boundary of the Para Block. East of this line rises the steep western face of the Mount Lofty Horst.

The Para Block is composed of highly resistant Cambrian and older sediments, heavily folded and very perfectly peneplaned. The visible portion of the block extends from beyond Gawler southward for 25 miles to Adelaide. It borders the western scarp front of the Mount Lofty Ranges and is fairly uniform in width—about five miles. The profile of this block may be seen to advantage from the Port River and thereabouts. The general surface level is some hundreds of feet above the plain at Gawler, 400 feet above the plain at the Little Para, gradually plunging downwards until it disappears below the plain at Adelaide.

In addition to its southward plunge, this block is, particularly from Golden Grove southwards, tilted easterly towards the range, a matter that has had important consequences.

The western scarp face of the Para Block is a marked feature of the landscape for its whole length, and has been one of the chief controls of all road and railway communication in its neighbourhood. This southward-plunging, eastward-tilted block is the most important of all the purely structural factors in the settlement and development of the city and suburbs of Adelaide. In a previous paper the writer referred to this as the Yatala Block (ref. 8, p. 12); Howchin has referred to its buried portion as the "Adelaide Shelf" (ref. 12, p. 148). From the point of view of the exposed portion of the fault block, the name "Para," however, seems the most fitting, being a native name (meaning water, *vide* Cockburn's "Nomenclature of South Australia") and having been associated with the geographical nomenclature of the block since the earliest days of settlement (sometimes spelt Parra, *vide* 1841 map). The block has undergone youthful dissection along the scarp face, with deeper valleys where it is crossed by the Little Para River, Dry Creek, and the Torrens River.

South of the Dry Creek Gorge the Para Fault Block shows little or no exposures of the bedrock of which it is for the most part composed. It becomes covered with soils and travertines, and the uplifted western edge forms the long northern ridge along which the residential area of Prospect, Nailsworth, Enfield, and other suburbs is spreading so rapidly. To the east and south-east the covering of younger rocks and of river gravels and alluvial materials becomes deeper and deeper owing to the southerly plunge and easterly tilt of the block, until its character is entirely lost in the general alluvial plain.

The effect of this tilted block on the Torrens River has been to divert it to the south-west; in its passage across this block we have the most beautiful, the most fertile, and the most historic portion of the whole Torrens Valley. The physiographic conditions at the western edge of the Para Block provide that this super-imposed river should there form a "gorge." This has been

done, but the block is so low, and the rocks here forming it—Tertiary limestones, alluvial, and travertine—are relatively so soft that the "gorge" is wide and mature-looking, bounded on the north of its mouth by Montefiore Hill and the adjoining elevated area of North Adelaide, and on the south by what we may call, for purposes of reference, the Newmarket Hill. This portion of the Torrens Valley has become the gateway through which passes the whole of the railway communication of the capital city. It was reserved by the founder for Park Lands and Public Buildings, and is largely so used.

(g) *Factors determining the City Site.*—We shall endeavour to show how the foregoing factors influenced or controlled the selection of the site of Adelaide. The earlier historical aspects will not be dwelt on at any length, since they have already been set down so fully in such papers as Grenfell Price's "Geographical Problems of Early South Australia" (Royal Geographical Society of Australasia, S. Austr. Branch, vol. XXV.), and elsewhere (refs. 15, 16, 17).

The successive factors in the selection of the site of Adelaide were:—

(i.) Gulf St. Vincent (shelter and central position).
(ii.) The Adelaide Plains (wide fertile spaces).
(iii.) The Port River Estuary (secure harbour).
(iv.) The Torrens River (supply of fresh water).
(v.) The Para Block (high level ground).

Colonel Light has set out the reasons that led him to favour the eastern shore of Gulf St. Vincent in preference to all other available sites, having in view the main factors of harbour facilities, fertile soil, water supply, and access to the Murray Valley. Price (ref. 16, 17) has shown that Sturt, before this, had expressed favour towards the eastern shores of Gulf St. Vincent. In this, Sturt and Light showed that topographic knowledge and instinct for which both men have already been noted.

The next factor was to discover a harbour for the sheltering of the immigrant ships that were following so closely. Here Light's observations and information led him to favour Barker's Inlet ("Sixteen Mile Creek"), discovered in 1831, mostly referred to by Light as "Jones' Harbour" (because of Jones' account of 1833). The fertile and beautiful plains of Adelaide all the more strongly inclined Light to find a harbour in their vicinity—fertile spaces being first among all the factors of human geography.

The search proved an elusive undertaking, on account of the peculiar physiographic features of the lower delta of the Torrens, and the fact that the chief arm runs parallel, and not normal, to the coast. The harbour was ultimately discovered, and, setting aside the vicissitudes of the search for the best site within the inner port, this decision formed the second step in the selection of the site of the "first city."

The next requirements were fresh water and good ground for a settlement. The lower deltaic plains were rejected for obvious and excellent reasons. The higher deltaic areas (above the 40-foot contour) were considered, were favoured by Governor Hindmarsh, but were ultimately rejected by Light because of the signs of occasional flooding. The Torrens promised to provide a water supply adequate for all requirements for some time, therefore it was decided that the settlement should lie along the river. A good city site should have some eminence and freedom from floods; thus the Para Fault Block came into the discussion. The site must also be as near as possible to the harbour.

For all these reasons it came about that the point nearest the harbour, where the uplifted western edge of the Para Fault Block is intersected by the Torrens Valley, was the determining point in the selection of the site of

Adelaide proper, and here, on February 11, 1837, somewhere about the corner now occupied by the Newmarket Hotel, the survey of Adelaide was begun.

This place, called "Newmarket Hill" in a previous paragraph, is a very slight rise (30-40 feet), but it is a most significant rise; it is the southward continuation of the scarp that appears across the valley in Montefiore Hill. It covers the position of a great north-south fault, the Para Fault, in which the adjoining western block (the Croydon Shelf) is thrown down some two thousand feet (ref. 12). On the Adelaide Plains, Nature provided almost ideal geographical conditions for the site of a city; Colonel Light wisely interpreted those conditions.

(h) *Factors influencing the Plan of the City.*—A variety of theories has been propounded and many strange stories told about the reasons for Adelaide being laid out as it is. Some of these accounts appear to be based on the quite unnecessary assumption that Light must have "copied" his plan from some other city. Others, possibly emphasising the fact that Light was a soldier, and forgetting that he was also a surveyor (and, as we know, an intelligent town-planner), have striven to see in the plan hidden ideas regarding fortifications, defences, range of guns, and many other matters for which we have no evidence. In this connection, the "stepped" arrangement of East Terrace has provided material for a number of theories.

It is desired to show, and to establish from Light's own words, that he designed the city to suit the physiographic conditions of the site, and that no military or other external considerations entered into the matter. This is exactly the attitude of mind with which we should have expected a trained and capable man to enter on his job.

The first important decision was to build the city in two parts, using the high level land (average height 140 feet above sea level) on both banks of the river, with the larger portion on the southern side (see fig. 4). This was determined by the lay of the land (consult military or hydraulic engineer's contour maps). The Para Fault Scarp being the western boundary, the angle at which the river came down from the north-east left a smaller elevated area north of the river than was available on the south. Light's first scheme, as shown in his map of February 7, 1837 (reproduced in Gill's "Biographical Sketch of Light"), was to make the smaller rectangular North Adelaide area parallel with the southern larger rectangular area of South Adelaide.

When the survey got down to details the finer points of the relief of the area naturally asserted themselves. North Adelaide was brought closer to the river, and tilted to one side to suit the contours of the country. Considerable additions (towards Pennington Terrace and Lower North Adelaide) were also made on the sunny east-facing slopes of the Torrens Valley. This brought the north-western corner of North Adelaide along the sloping face of the fault scarp; consequently Mills Terrace was "stepped off," as we know it now, by leaving out some of the blocks so that it would fit the contours.

The north-eastern corner of the proposed South Adelaide rectangle was also found to lie along a valley (the small valley that runs through the East Park Lands into the Botanic Gardens), and here also some blocks had to be left out, and East Terrace is thus "stepped off" to suit the contour of the site. The important part played by the contours in this lay-out may further be gauged by the emphasis placed on the shading of the more important slopes in Light's first detailed map of Adelaide, the one that shows the numbered acres (ordered by the House of Commons to be printed, January 26, 1838).

In the interior arrangement of streets and squares, and the setting aside of Park Lands, it is, of course reasonable to assume that memories of such cities as Catania and others played a part (*vide* "City of Adelaide Year Book, 1927," p. 232). But there can be no doubt that the general plan of the present

city of Adelaide was determined by a wise and thoughtful man seeking to make the best use of the geographical advantages of the site selected.

He has told us that he moved his camp to the site of Adelaide on January 3, 1837, so as to be near his work, and he then wrote in his "Journal" (p. 43):—"From this time to January 11 I was employed in looking repeatedly over the ground, and devising in my own mind the best method of laying out the town according to the course of the river and the nature of the ground."

There is possibly no other city in the world, of similar importance, where the various geographical factors determining the site can be so easily recognised and so readily confirmed from the words of the founders themselves. Having completed our account of the origin of the city on the Adelaide Plains, we shall briefly consider the rocks of the plains and then pass on to a survey of the adjacent mountain ranges and the rivers, returning in a later section to the question of the growth and development of the city and suburbs.

(k) *The Rocks of the Adelaide Plains.*—For the purpose of a survey of the rocks of the Adelaide Plains, we may consider the latter as comprising that triangular portion south of Dry Creek, and enclosed between the main Mount Lofty Scarp face and the sea (see fig. 4). These paragraphs should be read in conjunction with fig. 7, which shows five geographical sections across the plains. Dealing with the rocks, their resistance to erosion, their economic value, and the nature of their soils, we have:—

(i.) Cambrian and Older Rocks.
(ii.) Tertiary Rocks.
(iii.) Recent Rocks.

(i.) Cambrian and Older Rocks.—In this area the Cambrians and Pre-Cambrians consist largely of hard and massive quartzites, as seen in the Dry Creek quarries. They are intensely resistant to erosion, apart from the fact that they are usually very much jointed and fractured. They prove to be of little use as building stone, on account of the difficulties of quarrying and dressing. They are much used as ballast and as a road metal, but are of inferior quality for the latter purpose. They break down to form a porous sandy soil, characteristic of the plains.

(ii.) Tertiary Rocks.—These, as will be explained later, overlaid the whole of the Mount Lofty region in middle Tertiary times, and possibly up to the beginning of the Pleistocene. On the northern portion of the Para Fault Block they have been quite stripped off by Pleistocene and Recent erosion. South of the Torrens, on the buried portion of the Para Fault Block, these even-bedded fossiliferous limestones and clays still occur, overlying the peneplaned Cambrians and Pre-Cambrians; they are recorded in the well and bore sections in the area *(vide* Mines Department publications).

The beds outcrop with an easterly strike and a gentle southerly dip on the south bank of the Torrens, behind what is now Government House, but these outcrops are not now visible, the quarries having been covered over by later constructional work. These rocks were relatively easily eroded. They have been used with success as building stones; and they added to the value of the deltaic soils of which they formed part.

(iii.) Recent Rocks.—Recent deposits consist almost wholly of the water-borne accumulations consequent upon the uplift in early Pleistocene times of the various fault blocks of this area. Thus we have thick fault-apron conglomerates and fan-delta accumulations along the base of the main scarp front; gentler fan deltas, with gravels, sands, and silts, extending over the Para Block, and outward from the base of the latter to the sea, modified in their distribution by wind and tide and stream as already detailed in the preceding sections.

The later alluvial deposits of the Adelaide Plains are of wide variety, varying from the fine muds of the mangrove flats, upwards through silts, sands, gravels, and conglomerates, to huge blocks weighing 5 to 6 tons. The latter have been described by Howchin (Proc. Roy. Soc. S. Austr., vol 45, 1921, pp. 29-32). Over certain areas beds of clay predominate near the surface, and give rise to the so-called "Bay of Biscay" land, where buildings are liable to cracks owing to variations in the seasonal conditions of the soils. There is a wide belt of country in the eastern suburbs, from Prescott Terrace to the foothills, remarkable for the number of water-worn boulders, up to 6 inches in diameter. An excavation for deep drainage, open at the time of writing, shows an extraordinary accumulation of large boulders, at depths of from 2 feet to 10 feet, along Greenhill Road, from the Mental Hospital eastward.

The only other recent rock types worthy of mention are the travertines. These appear to be the modern relics of the tertiary overmass of limestone that once covered the whole of the Para Block; in other parts they overlie these limestones. They are quite close to the surface and shallow in depth, and are a result of the wet winter and dry summer of this area. They are specially marked in a belt extending through North and South Adelaide proper, and although friable and without any controlling joint planes, they were at one time used extensively for building purposes. The silts of the delta plains and the Torrens Valley provide beautiful orchard and garden soils, though clay belts of less value occur; the clays were, in the early days, used for pisé and brick dwellings, and later for making roofing tiles; the manufacture of bricks and tiles is still carried on.

The story of the progressive development of building materials is a most interesting one. The present city of Adelaide is built almost wholly of brick. stone, and cement. It is by far the most solidly built city of the Commonwealth *(vide* "Commonwealth Year Book"), possibly because of the combined facts of timber scarcity and abundance of brick and stone. According to the 1911 census, the following were the relative percentages of stone (including brick and concrete) houses in the various States:—South Australia, 85; Western Australia, 43; New South Wales, 42; Victoria, 36; Tasmania, 23; Queensland, 3. The early settlers used canvas tents and imported wooden houses. The use of brick and rammed earth (pisé) came in very early. Travertine, the handiest stone of the plains, followed. Then came the Tertiary limestone, and later the fine building stones of the quarries of the Mount Lofty Ranges—Glen Osmond, Mitcham, and Tapley's Hill slates and mudstones. Brick dominated the next period, and is still the chief building material, though stone is considerably used, with cement concrete for more important edifices.

VI.—THE MOUNT LOFTY RANGES.

(a) *Introduction.*—These ranges have been described in a general way in the opening section dealing with the Gulf Region and the Fleurieu Peninsula. We are here concerned only with the section reaching from the Torrens River area south to Cape Jervis. The Mount Lofty Ranges constitute one of the chief assets and one of the most keenly appreciated beauties of the Gulf Region of South Australia, and indeed of the whole State. The values of the "Hills" were eloquently, though briefly described by Sir Samuel Way (Unveiling of Light Memorial, June, 1905):—. . . "One of the finest plains in the world, under the shelter of the beautiful hills which have moderated the climate. They have secured us from drought, have furnished us with a beautiful water supply, and with a glorious picture." There is a popular belief that these ranges are of great geological age; actually they are young geologi-

cally (Pleistocene), although the rocks of which they are built are very ancient.

(b) *General Plan.*—The general plan of the Mount Lofty Horst is shown in figs. 1, 2, and 3. The chief facts of the geology and the structure are excellently set out in H. Y. L. Brown's 1899 Geological Map of the State, and in subsequent maps published by Dr. L. K. Ward (Director of Mines). The structural features have been dealt with by Benson, Howchin, Mawson, Teale, and others. The economic aspects have been described in various Bulletins by Mr. R. Lockhart Jack. Even before the structural fault-block features of the range had been observed, the relationships between the Tertiary and the more ancient deposits, as shown in Brown's map, had been set out in a most illuminating manner.

The step-faulted character of the Mount Lofty Ranges can be readily seen from any vantage point in Adelaide, as shown in the sketch (fig. 6). In fig. 7 five sections, with diagrammatic geological details, have been drawn from the available topographic information; these illustrate the step-faulted characer of the front of the range. That the early settlers recognised this structural peculiarity is shown by the name of "The Tiers," that used to be applied to the ranges. This name has quite gone out of use, except in the case of the more remote "Hindmarsh Tiers," still so called.

Benson, in his "Notes descriptive of a Stereogram of the Mount Lofty Ranges (Trans. Roy. Soc. S. Austr., vol 35, 1911, p. 108, ref. 1), recognised many of the outstanding fault lines. He recognised also that Mount Lofty and Kangaroo Island were one great tectonic unit, and not two (a north-south and an east-west) as sometimes supposed. Much additional assistance to the physiographer has since been given by the Commonwealth one-inch military contour map of Adelaide, and Edmunds' valuable form-line maps, that cover a greater area. The Lands Department's general form-line map of the hills district of 1897 is an invaluable aid. The large-scale contour plans (V.I. 2′) of the Hydraulic Engineer were kindly allowed to be transferred to a one-inch scale (V.I. 10′), which was carried out by Mr. J. A. Tillett, and this has been of great value in working out the physiographic history of the plains. Further survey work must be done in the hill areas before the whole story, even in general outline, can be told.

The main "blocks" of the ranges have been set out by Nature on broad and sustained lines. The differential movements of the various blocks are abrupt, as seen in sections across the range (fig. 5), but consists of gentle warping and plunging in direction parallel with the main fault line. Dr. Walter Geisler, of the University of Halle, who is familiar with block mountains on the Continent of Europe, told the writer that he knew of no place where the tectonic structures were to be seen so plainly and diagrammatically as are those of the Mount Lofty Ranges from a vantage point such as Chandler's Hill. The two frontal blocks (Burnside and Belair Blocks) are narrow and roughly flat-topped. Having ascended the latter at, say O'Halloran's Hill, the eastern blocks may be seen rising with long even sky-lines (the old peneplain levels) one behind the other. The steep scarp faces slope to the west, and the long peneplain faces lie towards the east.

The ultimate working out of the physiography of these ranges will involve long and detailed work for three reasons:—

(i.) The valleys are in many cases partly tectonic, *i.e.*, dominated by crustal movements, as in the major part of the Onkaparinga Valley;

(ii.) In the southern portions they are influenced *(vide* Howchin, Teale, and Mawson) by the re-exposed fossil landscapes of Permo-carboniferous times; and

(iii.) Over all these the influence of Pleistocene and recent erosive work and river capture have been exerted to bring about a harmonious drainage system; the conditions are particularly favourable to extensive captures.

The present writer does not follow Benson and Howchin in the belief that the old pre-uplift river system in the Mount Lofty Ranges was dominantly meridional, that is, that such rivers ran more or less parallel with

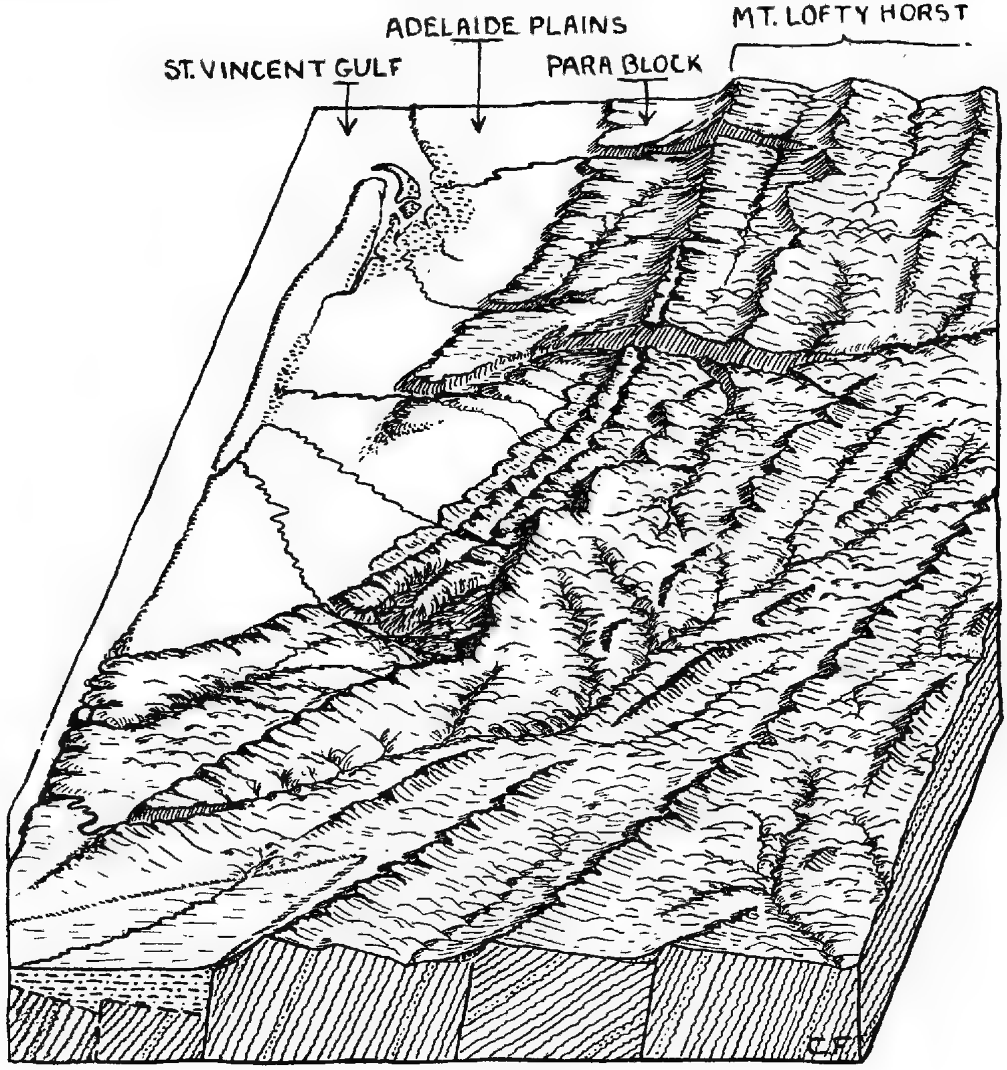


Fig. 5.

Block diagram of the area showing the Adelaide Plains, some of the tilted blocks of the Mount Lofty Horst, and the Torrens and Onkaparinga Valleys. This figure is purely diagrammatic, and is intended to suggest the leading structural features of the area.

the fault scarps, and he here puts forward an alternative explanation. It is quite possible that on the pre-Pleistocene limestone plain there was no river system whatever, just as we find on similar limestone plains to-day.

Wherever the writer has investigated block faulting in this and other States, an outstanding feature has been found to be the fault-apron of alluvial that lies along the base of each fault scarp (particularly along the Greendale and Bacchus Marsh series of faults, ref. 9) quite irrespective of the later development of the drainage networks. These alluvial accumulations might easily be mistaken as marking the courses of old linear streams running parallel to the fault scarps, whereas they have actually been deposited by short steep streams that developed on the scarp face, flowing at right angles to the lines of the alluvial deposits in question.

(c) *The Rock Characteristics.*—The various rock types, described as far as their resistance to erosion is concerned, are as follow. They are divided into two main groups:—

(i.) The Overmass.
(ii.) The Undermass.

A consideration of the facts as at present known regarding southern Australian physiography brings one to the inevitable conclusion that the whole of the great Cambrian and Pre-Cambrian complex, with later rocks protected in down-faulted or down-warped "pockets," had been planed down to a most perfect peneplain by the end of Oligocene time.

Over large areas in South Australia and Victoria this peneplain was depressed below sea-level in Mid-Tertiary times, when the shallow seas, known as the Murravian Gulf, extended eastward over southern Victoria and westward over probably the whole area that is set out as the "Gulf Region" in fig. 3. Thus the Mid-Tertiary coastline of South Australia was considerably to the north of the present coastline. This shallow sea slowly became dry land during the upper Tertiary period, and from then onwards up to the culminating period of the Kosciusko Uplift in the early Pleistocene, the overmass of level-bedded Tertiary limestones, perhaps three hundred or more feet in thickness, was uplifted. Where it covered the main horsts and was exposed by elevation it has subsequently been stripped off by erosion from almost the whole area, particularly in the case of the Mount Lofty Ranges.

The subsequent discussion of physiographic features necessitates a determination regarding this "overmass." Its existence appears to have been recognised *(vide* Howchin, in "An Outlier of Older Cainozoic Rocks near Mallala," Trans. Roy. Soc. S. Austr., vol 36, 1912, p. 14), but its profound influence on the subsequent physiographic history of the area does not appear to have been stressed.

The evidence for this "overmass" may be summarised as follows:—

(a) The Tertiary limestones come close up to the fault scarps that bound the eastern and western sides of the Mount Lofty Ranges. (In this connection see Bryan and Whitehouse, "Later Palaeography of Queensland," P.R.S.Q., vol. XXXVIII., No. 10, map on page 113.)

(b) The uplift (Pleistocene) is known to be younger than the limestones (Miocene).

(c) The limestones have been involved in the fault movements as shown by folded and tilted beds at various places along the Willunga-Noarlunga coast, as described by Howchin (Trans. Roy. Soc. S. Austr., vol. XXXV., 1911, p. 47; also vol. XL., 1916, p. 258).

(d) The overmass of limestone still remains in those places where the beds have been protected from erosion as on the plunging and dipping Mount Lofty Block at Port Willunga, on the Para Block where the limestones exist intact beneath the site of Adelaide, and on the depressed Croydon Shelf to the west.

(e) An outlying remnant of the uplifted limestones exists at the head of the Hindmarsh River, recorded by Howchin, Benson, and others, at an altitude of 900 to 1,000 feet. Elsewhere travertine deposits possibly bear witness to relics of the old Tertiary overmass, as suggested to the writer by Mr. P. S. Hossfeld.

(f) The great difference in the powers of erosion-resistance between this limestone overmass and the Cambrian undermass should satisfactorily account for the completeness with which the stripping has been carried out. (For accounts of the complete disappearance of overmass on uplifted blocks in other areas see refs. 5 and 9.)

The rocks are:—

(i.) Overmass—Tertiary rocks.
(ii.) Undermass—Cambrian and Pre-Cambrian rocks.

Tertiaries.—These have already been described or referred to in different places; they are relatively weakly resistant to erosion, level-bedded, and consist of limestones with interbedded clays and gravels, etc. They may be seen characteristically as low marine and river cliffs at Port Willunga, and at the mouth of the Onkaparinga.

Cambrian and Pre-Cambrian.—The younger of these two ancient series, as shown on current geological maps, lies mainly along the inner curve of the Mount Lofty arc, with the more complex older rocks to the east. The linear arrangement of the granitic masses of the Pre-Cambrian suggests that the same curving structure that is so characteristic of the latest tectonic block movement was originally impressed during the crustal movements of the early palaeozoic mountain-building epochs.

The rocks themselves are abundantly described elsewhere; they consist of grits, conglomerates, quartzites, slates, limestones, tillites, schists, gneisses, and plutonic rocks, all highly indurated, with silicification and recrystallization; they are extremely resistant to erosion.

All the beds are not, of course, of the same order of resistance; thus, in the scarp front that faces Adelaide, the less resistant argillaceous limestones, calcareous slates, and mudstones give us rounded hills and smooth-sided valleys, such as Green Hill—the vantage point from which Light surveyed the Adelaide Plains in February, 1837. The quartzites give us bold, high, scrub-covered hills such as Black Hill, and precipitous valleys and waterfalls as at Slape's Gully and Morialta. In addition, though it does not closely concern the Adelaide area, mention must be made of the Permo-carboniferous glacial deposits, readily eroded, and thus presenting once more to the air large areas of later palaeozoic landscape features (fossil landscapes), as first recognised by Howchin in 1910, and later described by him in the "Journal of Geology," Chicago, 1912, p. 200.

(d) *Main Structural Characters.*—An effort has been made to indicate the outstanding structures in a block diagram (fig. 5). From west to east we have:—

The Adelaide Plains and Estuary.
Para Scarp and Para Block.
The Burnside Fault Block.
The Main Scarp Fault, from the Little Para Gorge to Seacliff.
The Belair Fault and Block.
The Sturt Fault and Block.
The Mount Lofty Fault and Block.
The Willunga Fault and Block.
The Bulls Creek Fault and Block.

This summary does not attempt to cover the more obscure areas where minor or more eroded fault scarps are suggested. An effort is made to consolidate the present position by detailed descriptions of the blocks and reference to their economic significance.

The Adelaide Plains and the Para Block.—These features and their economic influences have already been dealt with in detail in Section V.

(e) *The Burnside Fault and Block.*—The Burnside block is really no more than a narrow "fault splinter"; it is described by Howchin (ref. 12). It has been so obscured by fault aprons and gravels that it is not easy to define the limits of either the block or its western boundary fault; but the bedrock is here and there exposed by quarrying operations. On account of the clays in the covering deposits, there is a row of brick kilns following along the line of this block (see figs. 6 and 7).

(f) *The Main Scarp Faults.*—This set of faults constitutes a tectonic feature of high importance; it dominates the geography of the whole Gulf Region. Within the area of fig. 3, it has a linear extent of over 100 miles, and the maximum movement along its face (in which, of course, more than one fault plane is involved) is of the order of 2,000 feet. In order of importance the Para Fault might be considered next, since this appears to be the dominating feature of portion of the eastern contour of the Gulf, and involves an additional downthrow of some two thousand feet. The Willunga Fault possibly comes third; a continuation of this line probably forms the northern face of Kangaroo Island (see fig. 3, and Admiralty Chart No. 2389).

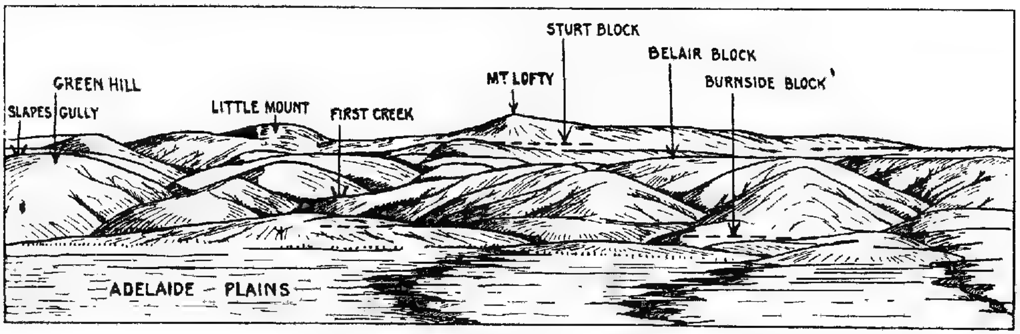


Fig. 6.

Sketch of portion of the Mount Lofty Scarp Face as seen from Adelaide, showing Mount Lofty and the step-faults; drawn from a photograph. This view covers only two or three miles of the scarp front, in its most deeply dissected part.

Viewed from Adelaide, the main scarp front is gracefully capped by the twin domes of Mount Lofty (2,334 feet) and Little Mount (see fig. 6). The old peneplain levels can be readily seen on the Sturt and Belair Shelves. The distinction between the treeless and the timbered areas that is so noticeable a feature (not indicated in fig. 6) is largely a matter of rock types. The limestones, mudstones, and slates have produced gentler slopes and better soils, with grass and trees, and perhaps also with a greater temptation to clear off the timber so that the grazing value of the land might be increased. The timbered areas, that appear dark in the distance, are covered by thick native scrub and undergrowth; the timber in such places is scrubby and not worth moving for its own value nor for grazing purposes; such dark-coloured hills are almost wholly of massive quartzites.

A very superficial examination of the spurs and gullies of the main scarp indicates to the geologist that any one fault-block, as here described, consists

in reality of a maze of blocks, a marquetry or mosaic of varying rock types and structures (see Howchin, Trans. Roy. Soc. of S. Austr., vol. XXVIII., 1904, p. 253, and Plate XLIV.). Positive details on these points can be determined only by an adequate geological survey. It is this variety of rock type and structure that gives to the western aspect of the range much of its beauty, with its graceful skyline and bold front forming a magnificent background for the city of the plains.

(g) *The Belair Fault and Block.*—The nomenclature which has been applied to these tectonic blocks is varied and confusing. While the name of the Belair Block has remained fixed, others have not been so treated. This is partly due to the varying aspects from which the features have been regarded. For instance, one author gives two different names to the same portion of one scarp within the limits of one paper. The present writer has adopted what seemed the most distinctive name, and has given to the western fault of each block the same name as the block.

The Belair Block rises to about 1,000 feet. It also is a narrow block, a mile or so in width, but broadening towards the south. The peneplain surface is remarkably well preserved in many places, so much so that on this much dissected area it has been found possible to establish golf links. These links are really set out on a remnant of the pre-Miocene Plain, an area carved down by slow processes of wave and running water millions of years ago. The Belair Block becomes one with the Sturt Block as it slopes downwards towards the south, where it forms the flat top of O'Halloran's Hill, a site that has been used for aeroplane landings. The block tapers and plunges, more gently, to the north, dying out towards Black Hill.

There are two features of special economic interest in the Belair Block. On an alluvial plain such as that on which Adelaide is built, the provision of material for roads and paths is most important. Thus it comes about that, because the nearest supplies of rock for such purposes may be obtained on the Belair Block, every other spur and gully has its quarry and rock-crushing plant. Along this block also are several of the chief pleasure grounds, relatively easy of access and providing a scenic change for the people of the plain; the chief are those of National Park (Belair), Waterfall Gully, and Morialta (see fig. 16). Towards the sea, limestones enter largely into the composition of the block, and give us gently-sloping grassy hills; here, also, are the Brighton Cement Works and the important limestone quarries established by the Local Government Department near Hallett's Cove.

(h) *The Sturt Fault and Block.*—This also is a long narrow block, but somewhat wider than the Belair Block, rising behind the latter towards Mount Lofty (see fig. 7). It is continuous towards the north, beyond the Torrens Gorge, where its western face probably becomes the main bold scarp that abuts on the Para Block. Towards the south the Sturt Fault dies out and the Sturt Block merges into the Belair Block. Where the two blocks become one, there occurs the extensive erosion of Coromandel Valley and the Sturt tributaries that come down from the National Park.

Some of the rocks here are more easily eroded, and the most southerly point at which the Sturt Fault is traceable is along the 1,000-foot line within the National Park, Belair; Picnic Point is on the Sturt Block, and the Pines Oval is on the Belair Block. In its highest portion (fig. 6) the Sturt Block is a deeply gullied one—a multitude of steep-sided valleys all running normal to the scarp faces; but from certain distant views, particularly from the north, the remnants of the level surfaces of these blocks can be clearly differentiated.

The southern extension of the Sturt Block is occupied by a small longitudinal stream that is important as the site of one of the chief reservoirs of the metropolitan water supply. The nomenclature of this valley or stream

is worthy of mention. It is well known to geologists as Field River; in a map of the State dated 1841 it is called Hurtle Vale; recent maps, such as the Military Contour Map, call it Hallett's Creek; while to the water supply authorities it is known as Happy Valley. In its lower reaches it is noted for its exposures of contorted Cambrian, or older, sediments, made famous by Mr. J. Greenlees' excellent photographs. There is some evidence that this valley was at one time the southern extension of the Sturt Valley.

(k) *The Mount Lofty Fault and Block.*—This is a broad block, very heavily dissected. It is the most elevated portion of the horst. It has been suggested that Mount Lofty and the Little Mount were monadnocks, residuals on the ancient peneplain, or alternatively that they were smaller single blocks that projected high above the general level and had been shaped by subsequent erosion. From the evidence presented by the summit levels throughout the ranges regarding the regularity of the pre-Miocene peneplain, and because the rocks of Mount Lofty, etc., are not of specially higher resistance than those of neighbouring eroded areas, the writer is inclined to regard them simply as the remains of the most highly elevated portion of the Mount Lofty Scarp (see fig. 5).

The Mount Lofty Block as a whole is highly resistant. Its outline dominates the appearance of the mountain skyline from the west, just as the block itself is chief of the difficulties of communication across the range (see fig. 6), and makes of the whole horst the barrier that it is between Adelaide and the Murray Basin—a barrier which still presses heavily on the economic welfare of the State. The block extends northward through Breakneck Hill and Mount Gawler towards Barossa, and on its northern extension the well-known Humbug Scrub occupies its western portion.

It is dominantly a quartzite block, but other varieties of rock (including limestones, phyllites, schists, and "diorites") occur, as seen in the fine section that is presented in the Torrens Gorge. To the southward it extends in a well-dissected ridge to Noarlunga, near which place it is cut through by the gorge of the Onkaparinga. In this locality, where some geological mapping has been done in detail by Professor Howchin, the mosaic character of the numerous interlocking blocks is prominently shown.

In its southern portion this broad block is tilted strongly to the east, abutting against the high Willunga Scarp. This eastward tilt provides the tectonic valley that is occupied by the Onkaparinga River for a considerable part of its course. The recognition of this character in the Onkaparinga explains much that would otherwise appear anomalous. As far as the available evidence goes, it would appear that the Onkaparinga may be regarded in part as a superimposed river, but its course has been profoundly affected by the faulting; its present valley is largely tectonic. Its superimposed character is suggested by the fact that it has been necessary, and possible, for it to carve a course through the rising western edge of the Mount Lofty Block, giving us the gorge near Noarlunga. The alternative possibility of this being due to capture by headward erosion must not be lost sight of.

Another interesting feature of this Mount Lofty Block, well shown in the block diagram in Teale's paper (Bull. No. 6, Dept. of Forestry, Univ. of Adelaide, 1918), is the formation, at the base of the Willunga Scarp, towards the sea, of a triangular area now filled by alluvial material overlying the Tertiary limestone overmass, here largely preserved (see fig. 5).

From its shape and its alluvial content the McLaren Vale triangle of plain has been referred to as the old estuary of the Onkaparinga. There is excellent evidence in favour of its tectonic origin, with the filling partly due to residual overmass and partly to rock waste from the surrounding ridges. The shape of the area presents none of the irregularities of an estuary, but

on the contrary is exactly defined by the faces of the adjoining tectonic blocks. Though the chief feature of this triangular area is its tectonic origin, the writer is not prepared to maintain that the Onkaparinga did not at one time flow into it, with subsequent diversion, or capture by headward erosion.

In its extension northward towards the Torrens Gorge, the Mount Lofty Block is occupied in part by the valley of Sixth Creek. From Upper Sturt, through Crafers, Stirling, Piccadilly, Summertown, Uraidla, to Cherryville, the sloping and dissected surface of the Mount Lofty Block is occupied by many fertile valleys with orchards and gardens that provide most of the fruit and vegetable requirements of Adelaide.

Before closing the account of the Mount Lofty Block, the writer would like to record his belief that there are certain definite minor blocks and fault scarps within this main larger block, as in the Mount Bold Ranges, the Forest Ranges, and Mount Gould. He has been unable up to the present to collect sufficient evidence to establish these suggested relationships. The deciphering of the detailed block structures of the Mount Lofty Horst will take many generations for its accomplishment. The present effort aims to be no more than one step forward on the work done by Benson (ref. 1).

(l) *The Willunga Fault and Block.*—This is a remarkable physiographic feature as we see it developed behind Willunga and at Sellick's Hill. The scarp loses its boldness and definiteness as we proceed northward. It has been greatly reduced by erosion in the upper reaches of the Onkaparinga and the Torrens, but possibly reappears more strongly in the ranges about Mount Crawford.

(m) *The Bull's Creek Fault and Block.*—Beyond the Willunga block to the east rises the level-topped scarp of the Bull's Creek Range. The continuation of this range along the general direction of the fault system, the physiographic evidence of the western front of the range, and its almost unbroken stretch along the Mount Torrens Range to the maturely dissected country about Mount Pleasant, suggest this to be another great tectonic unit. This portion of the area has not been examined in detail by the writer, and the fault is assumed purely on physiographic evidence. To the eastward there are indications of other blocks, sinking gradually to the Tertiary plain, but the country is more broken up, and not sufficient geological nor physiographic data have been collected to attempt any detailed definition.

(n) *Sections across the Area.*—One of the most productive aids to physiographic study is the construction of sections in areas where a detailed contour survey has been made. In fig. 7 five such sections are presented. These run from west to east across the Adelaide area, and are parallel to one another. They are drawn from the data given in the Commonwealth Military Map of Adelaide. The geology shown in the sections is purely symbolic, and does not suggest the rich variety of Cambrian and Pre-Cambrian rock types that actually occurs. A section through the ranges, showing the rock types and dips, has been made by Mr. R. Lockhart Jack, Deputy Government Geologist, but has not been published. The sections shown in fig. 7 pass respectively through the following localities:—(1) Golden Grove, (2) Port Adelaide, (3) Adelaide, (4) Mount Lofty, and (5) Belair.

These sections convey definite and valuable physiographic information, and little additional explanation or description is necessary. Evidence provided by them has been repeatedly used in the discussion of the physiographic features already dealt with:—

Section 1 passes through the low swampy areas of the Port River Estuary across the fan delta of the Little Para, reaching bed-rock in the uplifted Para Block, about 11 miles from the sea. On this block are the piedmont sands and gravels that extend down to Golden Grove, and which, from their

peculiar character (a general mixture of all sizes), have been found specially suitable for the making of certain types of modern roads. Beyond Golden Grove rises the bold timbered scarp face of the main range.

Section 2 passes through the sand dunes of Semaphore and the site of Port Adelaide. Six miles to the east, the Para Scarp is met at a lower elevation than in Section 1. The Para Block here appears to be much wider than it is in the first section, but this is partly due to minor variation in the directions of the fault lines. The exact relations between the frontal faults north of the Torrens Gorge (Sections 1 and 2) with those to the south (Sections 4 and 5) have not yet been worked out.

Section 3 commences on the outer dune belt at South Henley, and passes through the swampy area known as the Reedbeds (the Lower Deltaic Plain).

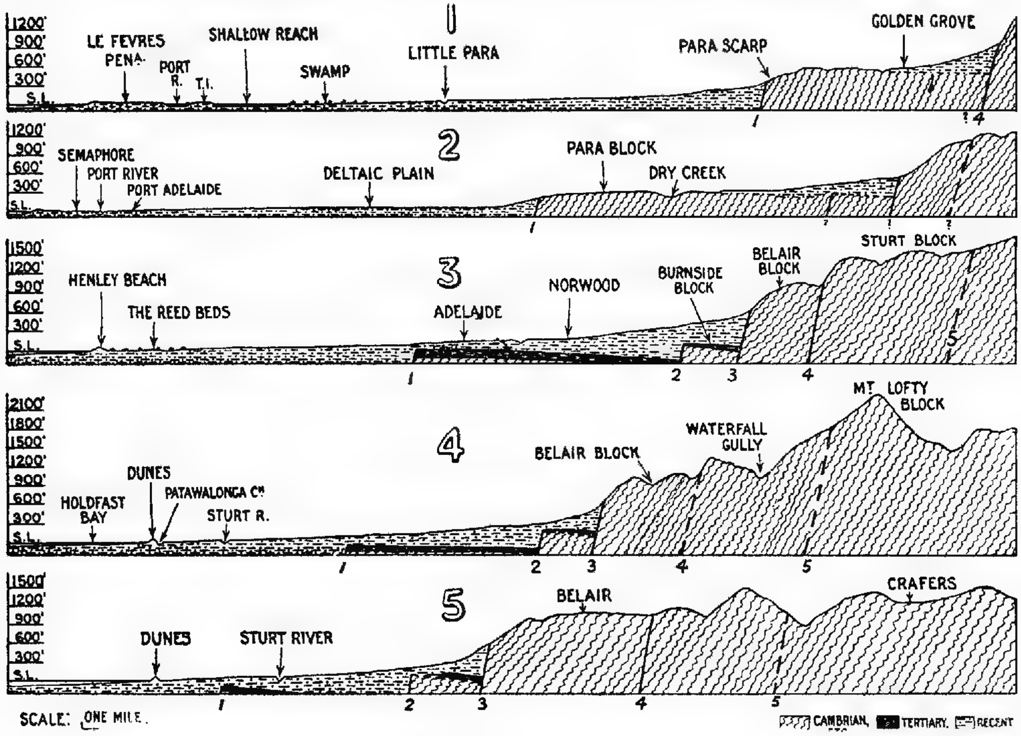


Fig. 7.

Parallel sections drawn from east to west across the Adelaide area. From topographic details given in the Adelaide Sheet of the Commonwealth Military Survey. Each section represents 16 miles from west to east and lies exactly south of the one preceding it; the geological details are symbolic of rock ages but not of rock types and structures.

Five miles from the coast is noted the slight rise that is due to the buried Para Block. This is the rise that determined the position of the capital. The section then passes across the alluvial that overlies the Para Block, with the higher piedmont accumulations covering the Burnside Block (500 feet) and rises rapidly to the Belair level (1,000 feet), then to the Sturt Block (1,500 feet) and finally in a less well-defined rise to the Mount Lofty Block (see fig. 6).

Section 4 crosses a narrower portion of the plain; the Para and Burnside Blocks are here hidden below the surface, and the main scarp of the range is met with seven miles from the coast. A much greater width of the ranges

comes into this section, owing to the south-west curve of the horst. The Belair Block is well defined; the Sturt Block is deeply dissected, and the massive Mount Lofty Block is here seen at its greatest elevation.

Section 5.—The alluvial plains in this section are narrower and the sand dunes are higher. The main scarp face is more gentle (here used for the trunk railway line), and is only five miles from the coast. The Belair Block, still at 1,000 feet, is wider; the Sturt Block here consists largely of glacial accumulations, and is more dissected. On the Mount Lofty Block are seen some of the tributary valleys of the south-flowing Onkaparinga.

(o) *Economic Influences of the Mount Lofty Ranges.*—The influence of the ranges on the rainfall and general climatic conditions of the main settled portions of South Australia is profound. An examination of a series of weather maps, and of the correlation between the isohyets and the contour lines as shown, say, on Ward's 1917 map of South Australia (see also rainfall graph in fig. 12), provides convincing evidence in support of the contention of the writer (A.A.A.S. Handbook, 1924) that "the very existence of the State of South Australia, as we know it, is dependent on the uplift of this arc-shaped highland belt," and the associated tectonic movements that formed the sunklands.

To come to details, we may consider the economic influences of the Mount Lofty Ranges under two heads:—*(i.)* those influences that are favourable to the State, and *(ii.)* those that are unfavourable. The favourable ones may be dealt with under five sub-headings; the unfavourable needs but one.

(i.)—Favourable: (a) Climatic influences.
(b) Water supply.
(c) Farm and garden areas.
(d) Health resorts.
(e) Scenic beauty.

(ii.)—Unfavourable: (a) A barrier to communication with the east.

The climatic influences have already been referred to. In brief, the climate of the eastern Gulf Region is cooler and the rainfall higher because of these ranges. Possibly the aspect of the country for ages prior to the Kosciusko Uplift was little different from the present-day aspect of the Nullarbor Plains or perhaps the Murray Mallee.

The account of the water supply needs little elaboration; the catchment areas are set out clearly in the map on fig. 8, made from plans published by the Hydraulic Engineer's Department. From the figure it will be seen that the greater part of the valleys of the two chief streams—the Torrens and the Onkaparinga—have been already utilized as catchment areas. The heavy broken line (B) represents the division between the highlands and the plains, whereon the site of the city of Adelaide is indicated at A.

It is along the line B (fig. 8) that the all-important geographical control of "height" becomes manifest. Water flows from a higher to a lower level; rain falls more abundantly in higher regions. Thus the higher region east of the fault line B gives us at the same time the double advantage of conveniently situated catchment areas with a rainfall up to 47 inches per annum (the highest in the State), and sites for high-level reservoirs. Thus the hundreds of thousands of people who live crowded together on the small triangle of plains west of the line B are able to obtain the abundant supplies of good water without which their existence would be impossible.

In fig. 8, G represents the Upper Torrens catchment that is diverted into the Millbrook Reservoir, the latter being shown with its own small catchment area at F. A second weir near the mouth of the Torrens Gorge draws upon the catchment area of the Torrens and Sixth Creek (E), the water being

diverted into Hope Valley Reservoir (C), and Thorndon Park Reservoir (D). These three reservoirs are also shown in the section accompanying fig. 9. The Onkaparinga Valley (J) is dammed at the Clarendon Weir, and diverted into the Happy Valley Reservoir, shown with its own small catchment area at (H). Fig. 8 indicates very clearly the extent to which the N.E.-S.W. tectonic lines have affected the shapes of the catchment areas concerned.

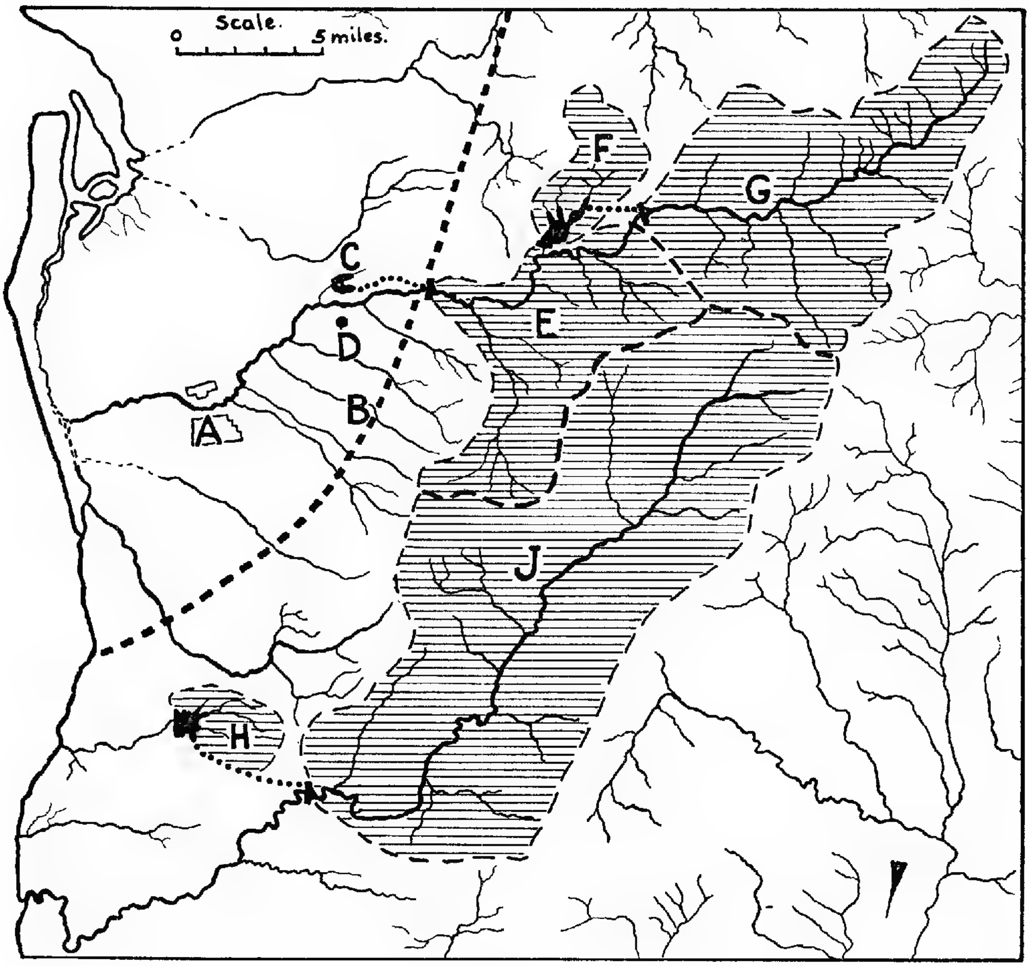


Fig. 8.
Map showing river catchments and reservoirs of the metropolitan water supply, as described in the context.

The main frontal scarp streams, including the Sturt and Little Para, run but little except in the heavy winter rains, and are then heavily laden with suspended material; these streams have at present no value from the water conservation point of view. Future extensions for the water supply will possibly be to the southward. The catchment areas to the north are already utilised, the Warren and Barossa Reservoirs being just beyond the area shown in fig. 8. The streams shown in the figure as falling eastward to the Murray basin are, with the exception of the Finniss, lower both in rainfall and in elevation.

The following are the details of the water supply of the metropolitan area, as published by the Hydraulic Engineer's Department; it will be realised that in the Torrens Valley the catchment areas overlap; the heights given are from sea-level (L.W.S.):—

(i.) Millbrook Reservoir.—Torrens Valley; catchment area, 88 square miles; low water, 916 feet; high water, 999 feet; capacity, 3,647,000,000 gallons.

(ii.) Hope Valley Reservoir.—Torrens Valley; catchment area, 135 square miles; low water, 295 feet; high water, 346 feet; capacity, 765,000,000 gallons.

(iii.) Thorndon Park Reservoir.—Torrens Valley; catchment area same as Hope Valley; low water, 282 feet; high water, 323 feet; capacity, 142,000,000 gallons.

(iv.) Happy Valley.—Onkaparinga River; catchment area, 170 square miles; low water, 448 feet; high water, 485 feet; capacity, 2,803,000,000 gallons—plus 390,000,000 gallons below low water level.

(v.) Proposed Myponga Reservoir.—Catchment area, 43 square miles; low water, 650 feet; high water, 715 feet; capacity, 3,621,000,000 gallons.

(vi.) In dry years the underground supplies of the Adelaide sub-artesian basin, in the Sturt district, have been tapped and pumped into the mains.

The numberless valleys of the upland areas, enjoying an abundant rainfall, abound with orchards, farms, and gardens, which provide the city of Adelaide with a fresh supply of varied foods. The less fertile highlands are the sites of week-end cottages and holiday resorts, furnishing welcome relief during the long hot summer months. Many country residences have also been built in these hills, where good motor roads make rapid communication possible for light traffic, despite the heavy grades. The scenic beauty provided by the foregoing features are an outcome of the varied structure and materials of the hills. There is a peculiar charm and variety in the harmonious way in which the hill villages blend with their physiographic and botanical environment, but the chief claim of the range to beauty lies in its position as a background to the plains of the city of Adelaide.

The unfavourable aspect of the range is unfortunately one that is of extraordinary importance. It constitutes a mighty barrier against communication with the Murray Valley and with the larger communities of the Eastern States. This is a serious aspect from the economic point of view. The difficulty has been emphasised and exaggerated by the series of happenings, spread over the last fifty years, that led to the main railway line being carried over what we know to be almost the highest and most difficult portion of the whole range. From the geographical point of view it is debatable whether the genius of the mechanical engineer, as expressed in mountain engines and heavy lines, etc., can overcome, in the most effective and economic way, the barrier presented by grades of 1 in 37, when a route with grades of 1 in 80 is known to exist.

It is of interest to dip back into the past in the attempt to discover:—First, why the main river crossing came to be at "Edwards' Crossing," or Murray Bridge as we now know it; and, second, why the route was chosen over the highest portion of the range. It is difficult to learn from the maze of parliamentary papers and contemporary documents, and from the columns of parliamentary debates, how far human motives, open and hidden, affected the position, and how far geographical factors and engineering advice was

allowed to come into the question. One thing is certain: A reasonably good contour map of the hills district, from Kapunda to Cape Jervis, would have greatly influenced the decisions made, and must have resulted in far-reaching economies as far as the choice of route was concerned. Unfortunately, no such map was, or is, available.

(p) *The Selection of the Site of Murray Bridge.*—The question of a harbour near the Murray Mouth is one that received the earnest consideration of the founders of South Australia, and it is one that becomes increasingly important with the expansion of settlement in the great Murray Valley. It is a remarkable fact that the Murray Basin—the greatest and most important geographical unit in Australia—has never received the political and economic consideration due to it. This arises largely from the political fact that the basin is divided arbitrarily into four areas, controlled by four States—these areas being separated, for the greater part, by the most unreal of boundaries, namely, meridians and parallels. Further, the State that holds the territory of the Murray Mouth is weak in numbers compared with the competing Eastern States (see S.A. Parliamentary Papers, 38/17 and 32/21).

The four capital cities controlling these four portions of the Murray Basin are all separated from it by high mountain barriers, over which the produce of the basin is hauled, at great cost, to the seaside. Two new factors have arisen to support the efforts that have been made to secure the natural geographical requirements of an exit for the Murray Basin via a port at, or near, the Murray Mouth. One of these new factors is the existence of a powerful and well-constituted body, the Murray River Waters Commission, and the second is the existence, for the first time, of a capital city (Canberra) within the Murray Basin.

From the Adelaide point of view, it may be argued that it is possible for Adelaide to be the Murray River port, as it does indeed to some extent function at the present time. Militating strongly against this possibility are two things: The existence of the main trunk line, the "Hills Railway," over a high and difficult range, with grades of 1 in 45 (without allowing for resistance on curves; actually 1 in 37). The second difficulty is the existence of the river port at Murray Bridge. The reasons for the present positions of the town and port of Murray Bridge are of interest; they tell the same story as the Hills Railway Line—a happy-go-lucky method of progress under the urge of local requirements and political expediency. Contemporary documents show that there was little, if any, regard for the more important considerations of the establishment of a Murray River port and the provision of Interstate communications.

A study of old Parliamentary Papers shows that the chief incidents in this story took place about sixty years ago. In September, 1864, it was considered that the traffic over the ferry at Wellington justified the building of a bridge over the Murray to enable communications to be made "with the South-East and with the land across the river." The traffic crossing the river at Wellington that year is set down as:—7,119 people, 852 carriages, 14,375 great cattle, and 83,638 small cattle. It is notable that no opinion was expressed regarding the possibility of the bridge site developing as a river port. The river was not considered as a mode of communication, to be so utilised, but purely as an obstacle or barrier, to be overcome.

From Parliamentary Paper 148/64 we learn that a select committee was appointed by Parliament to enquire into the Murray River Crossings: "as to the best site for establishing crossing places at the Murray and Lakes, *en route* to the South-East district, whether by bridge or ferry." It was then considered that the passage of stock and the horse-and-dray traffic justified a bridge. There were five competing sites: Wellington (where there was a

ferry), Thompson's Crossing (sites 1 and 2), Mason's Crossing, and Edwards' Crossing. These crossings were examined and reported on by Mr. C. F. G. Ashwin, Superintending Surveyor of the South-Eastern district. The reports were accompanied by river sections, that gave no information except the depths and widths of the river.

The whole matter seems to have been decided at last in terms of cost. The Wellington bridge would cost £22,436, the most expensive, while the cheapest (by £700 only) was that at Edwards' Crossing. And so the road bridge came to be at that place, and this same bridge was later used for the railway, until 1925; and there the town of Murray Bridge grew up, and naturally became the chief river port. Later the old road bridge was found unsuitable, and a new and separate railway bridge was built at the same site. The whole story is an example of the manner in which important geographical factors remain unconsidered, owing to the pressure of immediate necessities and political expediency.

(q) *The Selection of the Route for the "Hills Railway."*—As early as 1836 Sturt, Light, and others considered the question of the best means of communication between the Adelaide Plains and the Murray Valley. It was thought that an easy passage lay to the north (beyond Gawler). By 1880 railway transport had become all-important, and the need for more railway communication and the selection of a route for the "hills railway" had become a burning question. In Parliamentary Papers of that period the plans of the range areas are crossed by a maze of competing routes, from Burra-Morgan in the north, to Adelaide-Milang in the south. As Sir Douglas Mawson has pointed out (Proc. Roy. Soc. S. Austr., vol. XLVII., 1923, p. 372), the easiest route appears to be still further south—a route that was not then considered.

We may narrow down our consideration of the possible routes to four:—

(i.) Where the ranges fall away to the north—the "Kapunda Gate."
(ii.) The Torrens River Valley route.
(iii.) The Brownhill Creek, Sturt, Onkaparinga route.
(iv.) Where the ranges fall away to the south.

(i.) The Northern Pass.—This is used as a road and railway route, and is of great value; it is, however, too long (Brunhes gives "distance" as second in importance of all geographical controls, ref. 3), penetrates too much into the drier areas, and taps the river too far to the north (Morgan, 9 inches per annum) to be a satisfactory pass between Adelaide and the East.

(ii.) and *(iii.)*.—In Parliamentary Paper 175 (1874) Mr. H. C. Mais, Engineer-in-Chief, reported that "Nature has very broadly indicated two practicable routes, one through the hills *via* the Torrens Gorge, and the other *via* Brownhill Creek." He appears to have personally favoured the route that is for all practical purposes the one followed to-day, but which was first planned to go out easterly through Norwood and Glen Osmond, and up through the Brownhill Creek Valley, then onwards much as we have it now to "Edwards' Crossing" over the Murray, where the road bridge then was.

The trouble seems to have been that the railway route had to be considered largely from local points of view; "the railways follow the trade." Two great geographers, Ratzel and Brunhes, have emphasised the fact that railways are first built in short disconnected sections. Man's primal tendency is to think in terms of local needs; trunk lines are later developments. The Murray Valley and the Eastern States did not come very largely, if at all, into the picture. When the hills railway was under consideration, the important factors were the communities then established in the hills and beyond, and the existence of the road bridge over the Murray. Thus the present route was favoured (P.P. 226A) because it "would serve a better district, a larger population, and secure a greater amount of traffic than any

other line south of Gawler." Later, when rail communication with Melbourne was decided upon, the road bridge at Edwards' Crossing, and the established "Hills Railway Line" were naturally utilised on the score of expediency.

(iv.) The Southern Passes.—Of these Sir Douglas Mawson wrote in the paper already referred to (ref. 14): "At Peter's Creek the Meadows Valley may be entered at an elevation a little over 1,100 feet above sea level. By continuing down the Meadows Creek to the Finniss River, the Mount Lofty Range can be crossed without rising to any greater height. This is the lowest passage available across the range, and is the natural route for trunk line communication from one side to the other." The route referred to by Sir Douglas Mawson has been surveyed by the Engineer-in-Chief's Department, and references to same may be found in Parliamentary Papers 32/23 and 34/22. In the absence of a complete topographic survey of the hills, it cannot be decided that even this route is the best, but according to the data available from the records above quoted it has many advantages over the present route. It provides, for instance, a 1 in 80 compensated grade, compared with the 1 in 37 compensated grades of the present route; but the new route would possibly be a few miles longer.

Regarding the matter purely from the geographical point of view (that is, the reaction of man to his environment), it would appear that if railway communication is to continue to be the chief means of transport of goods, it may yet be found necessary to take advantage of this southern route. Anything that will minimise the barrier effect of these ranges, by allowing for increase of load and speed without increasing costs, must be of the utmost benefit to the whole State, but more particularly to the city of Adelaide. The establishment of a Murray port, or the division of the Commonwealth into a greater number of administrative units, would, of course, completely alter the aspects of the problem here considered.

VII.—THE TORRENS AND ITS ESTUARY.

(a) *General Survey of the Drainage System of the Adelaide Area.*—In this and the following sections we are concerned only with the streams that drain into the Port River Estuary, as set out in fig. 9, plus the valley of the Onkaparinga. No discussion is entered into regarding the drainage area of the Gawler (North and South Para) River to the north, the many streams that drain eastward into the Murray River, nor the lesser streams that flow to the south. The streams concerned in the estuary are the Little Para River, Dry Creek, and the Torrens and its tributaries (including Brownhill Creek and the Sturt River, *vide* fig. 9). It is the rock waste carried down by these streams that has built up the portion of the Adelaide Plains that most concerns us. It is these streams, also, that have incidentally provided our harbours—the essential gateways to and from the outer world. These streams, though small, are of varied history, and are of the utmost importance to the city of Adelaide.

(b) *Physiographic Evolution of the Area.*—In dealing with the physiographic history of the area we shall go back to the early Tertiary times, and shall consider as a whole the area shown in what is here called the Gulf Region (fig. 3). We know, from the foldings, intrusions, etc., that long prior to Tertiary times this area had been the site of great mountain ranges, possibly more than once, but with those very ancient features we are not here concerned.

In the less far-away period of the Lower Tertiary we may picture the Gulf Region as a great land area of fairly low relief, gradually being worn down to an almost perfect plain. This great low-level land area was composed almost wholly of Cambrian and Pre-Cambrian rocks. There is

every reason for believing that it was even then a marquetry of fault blocks. The present blocks of the main horsts must be to a very large extent a heritage from previous periods of diastrophism, but in the Pre-Miocene period they were all planed down to the same dead level—to be emphasised as separate blocks by the later uplift, aided by the etching of sub-aerial erosion along fault boundaries.

There is no recorded evidence of any river, lake or sea deposits of those days, but there doubtless were slow-flowing streams, and possibly lakes and

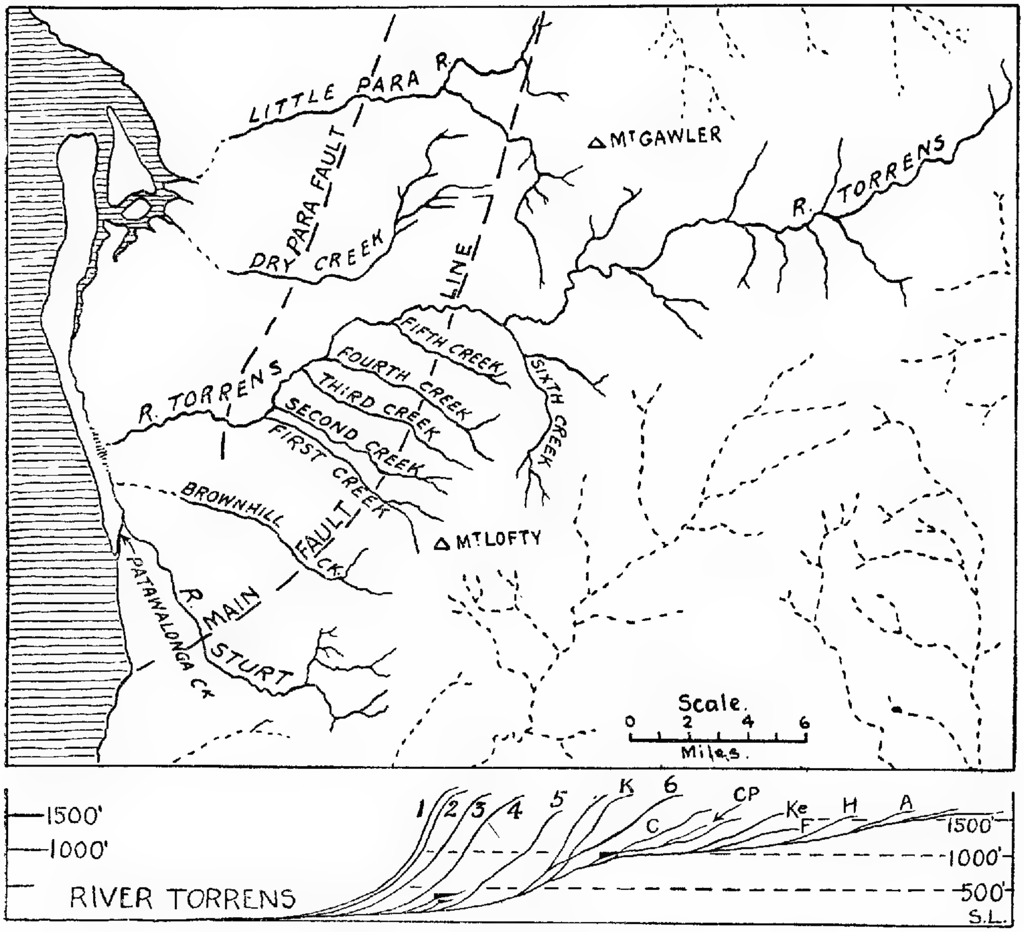


Fig. 9.

Plan showing the chief streams of the Port River Estuary, with section showing the grades of the Torrens and its tributaries, as described in Section VII.

swamps. The southern portion of the State was not the deeply indented and varied gulf region we know now, but a great lowland mass consisting of Palaeozoic and Pre-Cambrian rocks. Its southern boundary was not where our sea-coast now is, but it extended much farther to the south, beyond Kangaroo Island—just how far we do not know.

About Middle Tertiary times (some 20 million years ago, according to Barrell) this area was slowly submerged by shallow seas, whether by the rise of the sea or depression of the land we cannot say, though the latter is usually assumed. Chapman ("Victorian Naturalist," March, 1922, p. 127) records

basal Miocene fossils from Moorlands, just beyond Murray Bridge, testifying to the existence in early Miocene times of a sea or gulf there. This sea, through the following geological ages, advanced and receded, in evidence of which we have fossils that testify to swamps and estuaries wherein were laid down beds of lignite, etc. Chapman *(loc. cit.)* states that there were on the adjoining land areas luxuriant growths of timber and scrub, and that the climate was warm temperate.

This great shallow sea, which extended also over large areas in Victoria, has been known to South Australians as the Murravian and Eucla Gulfs. The present writer is of the opinion that this sea was of much greater extent than those geographical terms suggest. The existence of the Tertiary "overmass" of the Mount Lofty Ranges, which has been suggested in a previous portion of this paper (Section VI.), implies much vaster seas. It is reasonable to believe that the whole of the southern area of what we now know as the Gulf Region was covered by sea for considerable portions of Miocene time, when beds of limestones, clays, gravels, lignites, etc., were laid down. At Portland, Victoria, these beds are over 2,000 feet thick; in other areas they are so thin at the present time that the bedrock of the ancient peneplain shows through here and there.

Our second definite picture, then, is of a great shallow sea, extending from Victoria, over the Murray River area, over the site of the present Mount Lofty Ranges, over the St. Vincent and Spencer Gulfs, Yorke Peninsula, skirting Eyre Peninsula, and continuing to the Nullarbor and Eucla areas to the west. The southern shore-line of South Australia, that was once so much farther to the south, had now receded to the north, perhaps along an irregular line running from Overland Corner north-westerly to Streaky Bay, maybe even to Ooldea. Thus for perhaps the whole of the Miocene period the Adelaide region was at the bottom of a broad, shallow, southern sea, slowly accumulating a covering of marine rocks, with occasional emergences and temporary estuarine or swamp conditions. Nothing has so far been revealed to support the possibility that the Mount Lofty Horst was in existence as dry land during the Miocene marine transgression; as already detailed, there is considerable evidence to the contrary.

Regarding the following Pliocene period we are less sure. It is possible that there were no marked tectonic disturbances. Some portions of the land may have been warped gently upwards to become low land areas. Other portions remained covered by the sea, and limestones and clays, etc., continued to be deposited. Some of the Pliocene marine deposits are still preserved, both in sea cliffs and in deposits that are now 700 feet below sea level (ref. 11).

At the end of Pliocene time, and the beginning of the Pleistocene (about one million years ago according to Barrell's time scale), great and momentous changes occurred. Prodigious crustal forces were exerted, and the great period of relative uplift and depression that affected all southern and eastern Australia was initiated. This great orogenic movement culminated in what is called the "Kosciusko Period." During this period great founderings took place to the south (Jeffrey Deep) and to the east (Tasman Sea). (In a detailed discussion of the formation and age of the peneplain, see ref. 9, pp. 202-212.)

The area of the Gulf Region was gradually uplifted as a whole, but in certain less stable areas great faults occurred, and some blocks of land were uplifted while others were depressed. The Torrens Sunkland and the Spencer-Vincent Sunkland came into being (see figs. 1 and 2). The Flinders and Mount Lofty Horsts were uplifted, and the Gulf Region of South Australia began to take on the indented shape by which we know it now. The

uplift was gradual and differential, and, as Professor Howchin has shown on seismological evidence (ref. 11), it is still going on.

The raised blocks of the Mount Lofty and Yorke Peninsula Horsts, and the depressed blocks of Spencer and St. Vincent Gulfs were marked out during this catastrophic period, but all were not raised or depressed evenly. There is evidence, for instance, that the western blocks of the Mount Lofty Horst were raised to their present eminence somewhat later than the eastern ones. The physiographic features of the Mount Lofty Block, and those to the west, are much less mature than those to the eastward, even where the same river valley is concerned; this is a point of considerable importance.

Turning back to consider the great plains of Miocene limestones as they emerged from the sea, we may endeavour to form a mental picture of the first signs of uplift along the Mount Lofty Horst. On this slowly rising limestone block consequent streams would form, according to the lay of the land. It is perhaps to this time we must look for the origin of the directions of the more dominant streams such as those we are particularly considering: The Torrens and the Onkaparinga; but this portion of the story is admittedly obscure, particularly in view of the possibility that the pre-Miocene landscape contained river valleys that were later "exhumed."

As the Mount Lofty Horst more and more came to assume its present height and character, the consequent streams that first came into existence would tend to keep to their first channels, but they must have been in many cases greatly influenced by the tectonic lines, and possibly by pre-existing sediment-filled stream valleys. Deep valleys were cut into the overmass of limestones, and ultimately these continued into the ancient undermass.

With the assistance of the tributaries and associated streams the soft limestone overmass was completely cleared away, with the exception of the isolated remnants referred to in Section VI. (c). At the present time sunken blocks of these one-time continuous level sheets of ancient Miocene limestones are to be found at depths up to 2,000 feet and more below sea-level, and Pliocene occurs at depths of 700 feet, while remnants of uplifted Tertiary blocks still exist at heights of 900-1,000 feet above sea-level (ref. 11).

If we picture the blocks east of Mount Lofty itself to have been the dominant ones in the early stages of uplift—an uplift followed by a long period of comparative still-stand, we can understand why the upper portions of the Torrens and Onkaparinga, along with other valleys and ranges to the east and south, are of more mature character. The physiographic features of these valleys appear to be more mature than could have been accomplished since early Pleistocene time.

We may further picture a culminating period of uplift, when the western blocks (Mount Lofty, Sturt, and Belair) were somewhat more rapidly raised. The Torrens and Onkaparinga needs must devote themselves to vigorous downward erosion in order to preserve their valleys, and so we should get the steep gorges and deeply incised meanders of these two rivers where they cross the resistant western blocks.

Subsequently a period of comparative still-stand took place, and with the increased rainfall of the Mount Lofty area, the development of the drainage network proceeded apace along the lines characteristic of river action. Steep fault-front valleys, such as Brownhill Creek, Slapes Gully, Waterfall Gully, Morialta, etc., developed along the western scarp, and sent down their tribute to form the Adelaide Plains. Streams such as Sixth Creek, Sturt River, and Cox's Creek—given height and direction by the greater elevation of the Mount Lofty portion of the western blocks—carved out deep and steep-sided valleys. Meanwhile a totally different type of river evolution was in progress on the growing Adelaide Plains, as described later, and so there slowly developed the drainage network as we know it to-day (fig. 9).

(c) *The Torrens River Valley.*—The general outlines of the Torrens and its valley are shown in figs. 8 and 9. The physiographic history has already been told in broad outline, and only a brief description will be necessary, with some attention to the influence of the various geographic factors on man's occupation of the area. As already detailed, this valley was one of the favoured sites for a railway route across the ranges, but was not so used. The incised meander of the Torrens Gorge presented such difficulties to communications that it is only within the past few years that a road has been constructed there. Now, however, it forms the main road route to Mannum. Previously the mature and well-settled upper portions of the Torrens Valley were served by a road that climbed over two high scarp faces to the north, *via* Tea Tree Gully. Influenced by the settlements of Tea Tree Gully, Inglewood, etc., the motor-bus route still goes *via* those villages, despite the steep grades.

The Torrens Valley will be described under the following headings:—

(i.) The Upper Torrens, from the source to the Gorge.
(ii.) The Torrens Gorge.
(iii.) The Klemzig Valley, from the mouth of the Gorge to the edge of the Para Block, below Montefiore Hill.
(iv.) The Lower Torrens, the canal-like stream that crosses the deltaic plain to the Reedbeds.
(v.) The Patawalonga Creek.

A separate subsection will be devoted to a consideration of the Port River Estuary.

These five sections of the Torrens Valley can be clearly differentiated in the section showing the grades of the streams, which is reproduced on a small scale in fig. 9. The gentle grades of the upper valley, the steeper grades within the Torrens Gorge, with subsequent flattening on crossing the fault line, are readily seen. Similarly, the up-stream tributaries can be noted as gentler in grade. Between the tributaries numbered 4 and 5 may be seen the two small fan-delta streams on which the Hope Valley and Thorndon Park Reservoirs are situated. The Millbrook Reservoir may also be noted in fig. 9, on the 1,000-foot line. In the figures presented by Mr. J. T. Furner to the Flood Waters Commission (P.P. 35/25) the fall of the Upper Torrens is shown to be 28 feet per mile, within the Torrens Gorge it is 75 feet per mile, while on the lower deltaic plains it is 5½ feet per mile.

(i.) The Upper Torrens.—This valley is roughly parallel-sided, trending south-west across the structure of the country, but not uninfluenced by the block-faulting (see fig. 8). There are a number of small tributary streams, such as Cudlee Creek, Chain of Ponds, Kenton Valley, and Angas Creek. The grades and the valley shapes indicate a stage of erosion approaching maturity. The river is usually regarded there as a superimposed consequent, as already described. The country is well-grassed, well-watered savannah country, passing into bushlands (30-inch average rainfall), and it supports several picturesque and thriving townships, such as Mount Pleasant, Birdwood, Gumeracha, and Chain of Ponds—farming, dairying, and pastoral localities.

A distinct change in the character of the valley occurs below Birdwood; it becomes narrower and the grades become steeper. Towards Gumeracha the influence of pegmatite dykes and other rock structures is marked. The valleys open out again at the junction with Cudlee Creek, but neither here nor towards Millbrook can the physiography be regarded as older than early adolescence. Indeed, the whole course of the Torrens, as of the neighbouring Onkaparinga, is anomalous. In a normal river, the work is most advanced at the mouth and least in the headwaters; in the Onkaparinga, and more notably

in the Torrens, we get the mature valleys at the source of the stream, and an increasingly youthful physiography as we proceed downstream; an explanation of these features has already been suggested. Another suggestive feature is that the northern tributaries, such as Chain of Ponds and Forreston Creek, have gentler grades than the southern tributaries, Kenton Valley and Angas Creek (see fig. 9).

The rocks are largely Pre-Cambrian, and provide good soils. The ancient rocks provided some gold and other minerals, and there was considerable mining activity here in earlier days. In addition to its natural beauty, this valley gives to Adelaide a considerable amount of produce, is the chief catchment area for the metropolitan water supply, and provides a fairly easy pass to the Murray River Valley at Mannum. The possibility that the stream, above Gumeracha, was once the headwaters of the Onkaparinga, is worthy of investigation. There is a low wind-gap just to the west of Mount Torrens (1,500 feet), where the Torrens, above Birdwood, may once have flowed through to the Onkaparinga.

(ii.) The Torrens Gorge.—This portion of the valley is generally accepted as ante-consequent (ref. 8), but the possibility of headward erosion and capture cannot be dismissed without further investigation. Its origin appears, in either case, to be due to the later and perhaps more rapidly rising western blocks of the horst, into which it has cut a deep gorge practically without tributaries, the important exception being Sixth Creek. Through this gorge, by the ingenuity of engineers, there has now been made an excellent motor road, along which is laid the important arterial pipe-track from the Millbrook Reservoir. This gorge was for many years almost as complete a barrier to traffic as the ranges themselves.

The grade of the river is high, and all the features of extreme youth or rejuvenation are obvious. On physiographic grounds alone, the gorge would appear to be Pleistocene, at least in part. The rocks are most complex, as described by Benson (ref. 1; also Trans. Roy. Soc. S. Austr., vol. XXXIII., 1909, p. 101), and consist of massive quartzites, phyllites, schists, limestones, and igneous intrusives. The value of the gorge to man is, like rugged areas elsewhere, mainly as a pass and for its scenic beauty. It is a catchment area for the city water supply, there being a weir near the mouth. The igneous rocks ("diorites") provide good road metal. The only settlement in the gorge is an occasional small refreshment house.

(iii.) The Klemzig Valley.—The portion of the Torrens Valley from the mouth of the Gorge, across the Para Fault Block, to the western boundary of the latter, is fertile, beautiful, and of historic interest. It is well settled, partly with orchards, vineyards, orangeries, and gardens, and in part (closer to the city) with residential suburbs. In the early years of the settlement it was, as now, noted for its beauty and fertility. The valley is wide, and being in soft alluvials and limestones, had reached an almost mature form—a later general uplift has led to the formation of vertical banks cut into its own alluvial deposits. Owing to the tilt of the Para Block the Torrens is here diverted to a direction considerably south of west, and the right (northern) side of the valley has steeper slopes than the left side. In the higher (fan delta) portions are situated the storage reservoirs of Hope Valley and Thorndon Park.

The river at present flows between steep banks of alluvial, in places up to 50 feet high. These consist chiefly of rich deposits of unbedded silts, with current-bedded sands and gravels below. Near Walkerville there occurs, from 10 to 20 feet above river level, a layer in which there are abundant trunks of what appear to have been river red-gums; this deposit may be due to some unusual combination of bush-fire and subsequent flood.

In its passage through the city the valley of the Torrens was happily reserved for Park Lands and public buildings, and is so used. There are found many beautiful public parks and gardens, memorial drives, botanic gardens, zoological gardens, the University oval, the Adelaide sports oval, and the municipal golf links; Government House stands on its southern slope, and the Anglican Cathedral towards its northern slope; the later additions to the University buildings tend to turn their faces towards the more beautiful aspects of this valley. In its passage through this part of its course the river has been dammed by a weir to form an ornamental lake.

Perhaps the most important economic value of the lower portion of this section of the Torrens Valley is its use as the main railway gate of the city (*vide* J. R. Richardson's map of Adelaide, 1923); the whole of the railway communication between Adelaide and the rest of the State and Commonwealth passes through this gap. A minor exception is the South Terrace line to Glenelg, but this is moribund and will possibly be abandoned as a railway line.

In its passage across the Para Block, the Torrens receives no tributaries on the north, though the present headwaters of the Dry Creek at one time entered from the higher parts of the Para Block to the north.

On the south, the Torrens is reinforced by the small scarp-face tributaries known as First, Second, Third, Fourth, and Fifth Creeks. As already explained, the easterly tilt of the Para Block has deflected the Torrens to the south-west, a fact of great importance in its bearing on the original plan of North and South Adelaide [see Section V. (b)].

(iv.) The Lower Torrens.—For the last six miles of its course, after leaving the Para Block, the Torrens flows a little south of west, in a meandrine course, through its own deltaic accumulations. There is no valley; natural levees are marked in several places. The stream is in a canal-like channel, of diminishing dimensions as it proceeds down-stream—a geographical factor of high importance in the problem of the disposal of flood waters. The plain over which it flows has already been described [Section V., (c) and (e)]; brick-pits are numerous along portion of the course. Past Torrensville, a branch breaks away to the south-east (Breakaway Creek). Thence onwards is the well-known Reedbeds area—a growing portion of the lower deltaic plain—mostly swampy in winter and providing excellent grazing areas in summer.

A road and tram-line cross this swampy area, despite the physiographic unsuitability, and consequently each winter brings forward difficulties of communication in these routes. Here the waters of the Torrens, that have not percolated into the deep alluvials of the deltaic plain, divide and form wide swamps. Portion ultimately flows south along the coast some distance back from the sand dunes, and becomes the Patawalonga Creek; the remainder of the Torrens water, largely divested of its suspended material, flows north behind the dunes, into the Port River Estuary. The chief economic influence of the Lower Torrens, apart from the provision of excellent summer grazing areas, is the recurrent floods that it brings to those who dwell along its lower reaches, coupled with the fact that, like all deltaic streams, the river tends to overflow its banks at places up-stream each flood-time, and thus to change its course.

In the problem of the metropolitan floodwaters, as in the problem of the Hills Railway, the Murray Bridge, and the Murray port, the geographer may find most illuminating and valuable evidence in the various reports preserved in Parliamentary Papers. The outlook of the geographer, being impersonal and unaffected by questions of expediency, is naturally somewhat different from that of persons required to make decisions involving questions of public

policy and the expenditure of money. In the case of the floodwaters for instance, with due admiration for the scheme that has been drawn up and presented to the Committee, the geographical attitude would be somewhat like this: The area subject to inundation comprises some 4,000 acres that Nature is slowly building up by the same methods whereby the remainder of the plains was built. This area has certain values to man, but it is not at present suitable as a residential locality. The cheapest and most effective method of raising and improving this land is by means of the River Torrens itself.

If the whole 4,000 acres were resumed and placed under capable engineering control, as far as the roads, bridges, and drains, etc., are concerned, there would some day be available a magnificent addition to the residential areas of Adelaide. An inspection of the map (fig. 15) showing the present distribution of the metropolitan population will assist in illustrating this point. It is admittedly unwise to interfere with the natural courses of rivers and currents, etc., but where we are compelled to interfere every effort should be made to discover the methods along which Nature is working, and then to carry out our new designs along those lines, with the help of the natural forces that we seek to control.

In the present case, for instance, the diversion of the Torrens River to a direct route into the sea south of Henley Beach, by means of artificial levees, with a concrete channel through the sand dunes, would possibly have at least three after-effects, as far as interference with Nature is concerned. These are:—

(i.) The lower portions of the deltaic plain would be robbed for ever of their increment of silt, and must, therefore, remain low land.

(ii.) The Port River would no longer have the addition to its ebb tide of the Torrens water, a fact that may in the course of years have a profound influence on the port.

(iii.) The silt deposited at the mouth of the concrete channel during floods would form a shoal, just as Point Malcolm has formed the Wonga Shoal, and the influence of wind and tide would be to cause a shallowing of the sea at Henley Beach and Grange, such as is now taking place north of the Wonga Shoal.

(v.) The Patawalonga Creek.—This is here regarded as portion of the Torrens River; it may be considered as the south arm of the present Torrens Delta. From the point of view of origin, it is much more likely that it is a quite modern and accidental physiographic feature, not in any way a part of the original drainage network. When one compares its present appearance with the pictures drawn and descriptions written in the early years of settlement, it appears that considerable degeneration must have taken place in this feature during the past 90 years.

For reasons set out in dealing with the evolution of the streams on the plains, the writer considers that the Patawalonga Creek was formed by the temporary damming up of the waters of the Sturt and Torrens during a period of heavy flood, possibly combined with spring tides and westerly winds, with a consequent breach through a low portion of the sand dunes at Glenelg and the formation of the Patawalonga Creek.

(d) *The Development and Drainage of the Plains.*—The so-called "Port River Estuary" is really the estuary of the Torrens and associated streams, as shown in fig. 9. Economically it is of high importance, being the chief gateway for communication between South Australia and the rest of the world The so-called "Port River" is really the tidal portion of the River Torrens.

A physiographic discussion of the estuary involves consideration of the evolution of the streams that at present flow over the southern Adelaide

Plains, from the Little Para to the Sturt. This in turn involves consideration of the origin and growth of the plains themselves. A plan of the present estuarine area is shown in fig. 11, and the writer's conclusions regarding the development of the plains and drainage are set out diagrammatically in fig. 10.

(i.) The Rivers of the Plains.—One authority has divided streams into two classes according as their thalwegs are: *(i.)* "concave to the sky," or *(ii.)* "convex to the sky." The streams in the area shown in fig. 10 partake of both characters. In the ranges, east of the main fault line, they are concave to the sky, busily engaged in deepening their valleys. But when they cross the fault

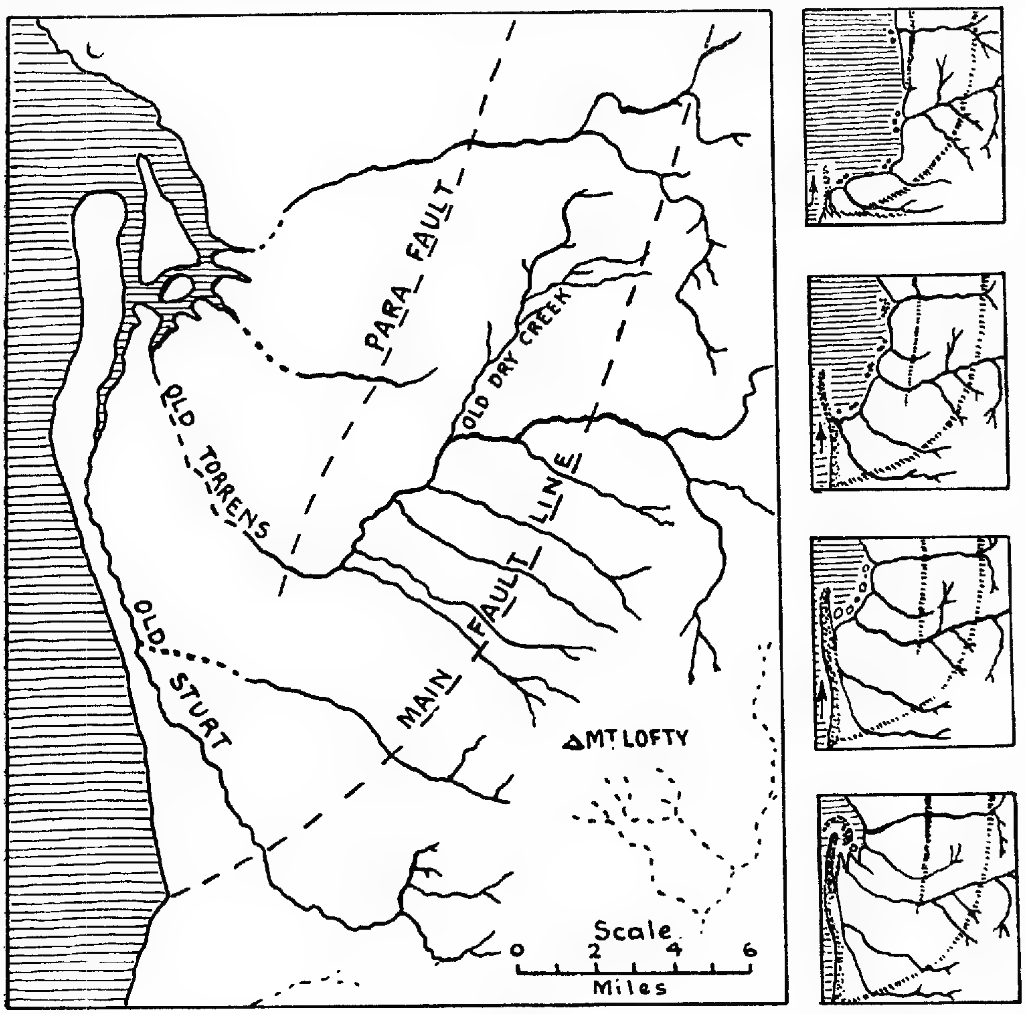


Fig. 10.

Plan to indicate one of the later and more important stages in the development of the Adelaide Plains, the streams, and the estuary. The smaller diagrams show progressive stages, reading from top to bottom.

their "valleys" become convex to the sky; they are accumulating, aggradational streams—engaged in building up and extending the land areas over which to prolong their existence.

Given the silts and muds that were carried down so abundantly from the uplifted blocks, the factors that controlled the building of the Adelaide Plains

are of two kinds: *(i.)* wind and wave; *(ii.)* running water. Wind and wave contrived to build up the long sand-spit from the rocky point of Seacliff northward, until it now reaches to Pelican Point at the end of LeFevre's Peninsula. The prevailing S.-S.W. winds and the tidal sweep were the chief factors in this work (see Section IX.), and the physiographic evidence needs no elaboration.

Thus the southern plain-building streams—the Sturt, Brownhill, and Torrens—would tend to be diverted northward, as suggested in the small progressive sketches in fig. 10, and the deltaic plain, bounded on the west by the sand dunes, would be forced to concentrate more and more towards the north-west. This theory might be elaborated in detail, if space permitted. Long continued examination of the area, and careful consideration of the physical features, do not suggest any alternative scheme that provides so well for the present shapes and characteristics of the shore-line and the estuary.

The evidence for the one-time direct northward flow of the Sturt River (see fig. 10) lies in part in the present anomalous relations between the Sturt and Patawalonga. The Sturt at present flows directly north, and then enters as a tributary into a south-flowing stream. This peculiar anomaly of the Sturt presents no difficulty when considered in conjunction with the suggestion above put forward regarding the recent origin of the Patawalonga. There is reasonable ground for the belief that the Sturt originally flowed northward, marching with the growth of the sandhills, and ended in the present Port River.

An examination of the Torrens River and the contours of the higher deltaic plain, supported by the evidence in the field, shows that the Torrens once flowed north-west, almost parallel with the present Port Road, entering the arm of the estuary that lies to the east of the present Port River. It may be urged that the Torrens also occupied, during the building up of the deltaic plain, a thousand other positions. This is true; but the evidence of the course, as shown in fig. 10, is so definitely demonstrated in the 2-foot contour maps of the Hydraulic Engineer's Department that one can only conclude that this particular course was the last one prior to the adoption of the present channel, and that it was one that was followed for a long period of time.

The fan delta which was (see fig. 4) built up towards Woodville and Cheltenham by the old Torrens has been of great economic importance. It has facilitated the building of the Port Road and the Port Railway, and has rendered the establishment of the adjoining suburbs a much more reasonable proposal than would otherwise have been the case.

With all these streams (shown in fig. 10), each a heavy silt-bearer in times of flood, carrying their burdens of water and suspended materials towards the estuary, that feature gradually became silted up, low plain replacing shallow water, until we arrive at the present stage (fig. 11) of an estuary with numerous arms and mud islands.

The later diversion of the Torrens to the present westerly course, which took its origin at a point near the head of the fan delta, illustrates one of the commonest characters of aggrading streams. The formation of the Patawalonga, on account of the breaking through of a flooded lagoon and the consequent diversion of the Sturt River, brings us to the condition of the drainage network of the plains as we find it to-day (fig. 9).

(ii.) The Port River Estuary.—The present estuary of the Port River is a place of considerable beauty, of high economic importance, and of scientific interest. Considered from the physiographic point of view it presents three peculiarities: First, it is the only extensive break in the eastern coast of Gulf St. Vincent, though other rivers enter to the north; second, it is clearly

an "outsize" as far as the present contributing rivers are concerned; thirdly, as Sir George Buchanan *(loc. cit.)* has remarked, it receives practically no silt in the main channel—a factor of great economic importance. We shall consider these three peculiarities in turn.

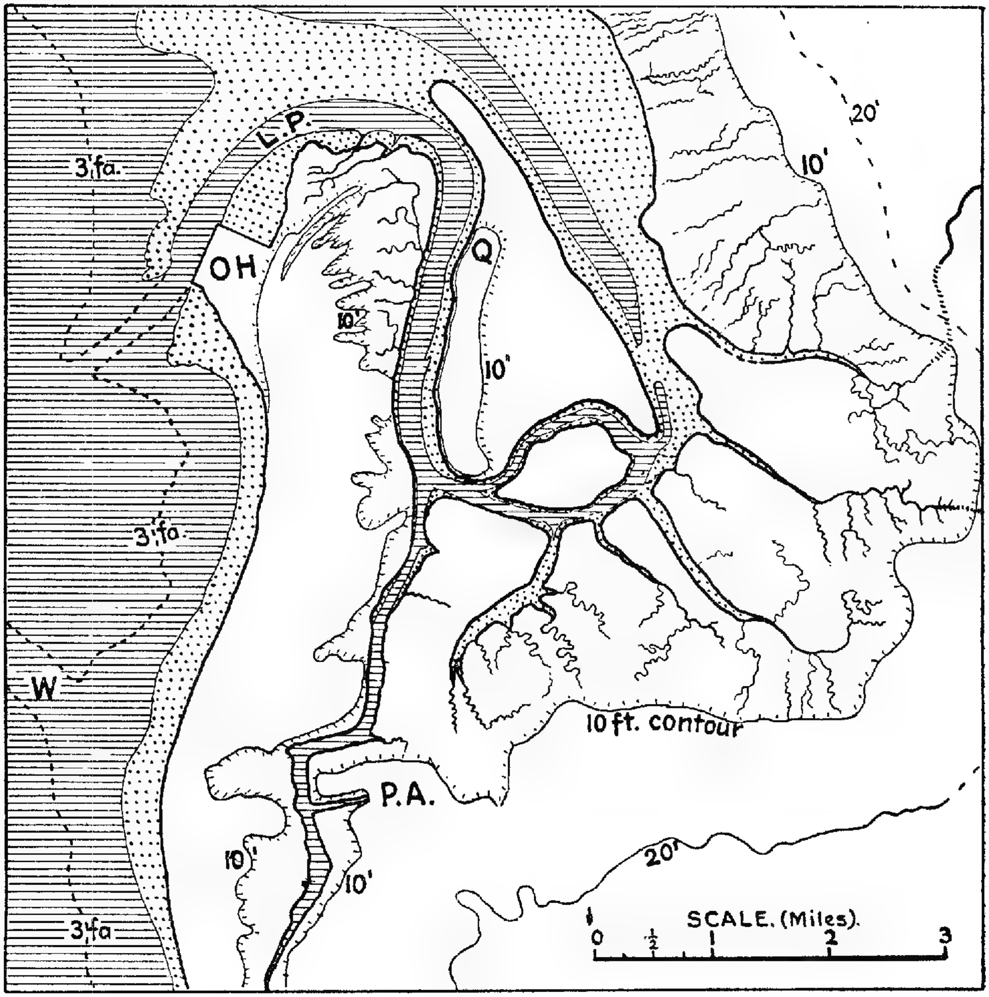


Fig. 11.

Plan of the Port River Estuary, showing the sites of the Inner Harbour (P.A.), the Outer Harbour (O.H.), and Light's Passage (L.P.). Five contour lines are also shown: (1) The 3-fathom line, (2) the low water line, (3) the general coastline (high water), (4) the 10-foot contour line, (5) the 20-foot contour line.

From fig. 11, which has been drawn to show the significant features of the estuarine area, we see that the whole site is one of characteristically low land and shallow water. The coast has been demonstrated to be a rising one (ref. 11), and presents the characters common to such areas. The land below the 10-foot contour is the least valuable land portion of the whole area, but it is the one that presents the greatest physiographic interest. Unfortunately, the study of such areas—those that are as yet neither sea nor land—is carried out with difficulty, and the writer has not had the facilities for proper examination.

The most recent method of studying such localities, where they are of potentially high value, is by means of aeroplane photographic surveys—a method not yet introduced into Australia. Tortuous tributaries, that run over the mud flats in a vagrant way and unite to form peculiarly wide and shallow tidal arms, are most characteristic of such areas (see fig. 11), and are of types quite distinct from ordinary land features. So important are the under-water features in the area of the Port River Estuary that the preparation of an aerial photographic survey is urged. Such a survey would reveal the details of shoals and channels which, if duly studied and interpreted, must profoundly influence future improvements and harbour developments.

The deepest portion of the estuary is that known as the Port River, or the Port Adelaide River, with its hook-shaped continuation discovered by Colonel Light in 1836, and named Light's Passage. The Port River is usually described in four reaches: (1) The "Old Port Reach," the shallowest portion, reaching up to the first bend past Jervois Bridge; this is still bordered in places by muddy mangrove flats; it was here that the first river port, the much maligned "Port Misery," was founded, and of which some of the old timbers still remain. (2) The "Gawler Reach," is the eastward flowing portion, the shortest and busiest portion of the river: (3) "Hindmarsh Reach" runs thence up to the place where the North Arm enters from the east.

Beyond that there was originally a "Lipson Reach," but the name is not found on later maps. There is a minimum depth of 26 feet at the low water springs ($31\frac{1}{2}$ feet h.w.s.) in the inner harbour, and of 33 feet, l.w.s., in the outer harbour. Since this river forms the chief gateway of South Australia —the avenue of communication with "Home" and with the markets of other lands—we may enquire why so good a harbour occurs in such an unfavourable area (namely: shallow gulf, silt-bearing streams, and a rising coast).

The lower reaches of the Port River, with the mangrove-fringed North Arm and Angas Inlet, are places of much beauty. In the Port River itself, sand dominates in some places, mud flats in others, according as the building agent has been wind and current or river and tide, respectively. Characteristic of this part of the river are "hooked creeks," such as Mutton Cove, entering the river in an upstream direction at a sharp angle with the bank —typical tidal features. In Light's Passage the river banks are still in the process of "becoming," as also at Outer Harbour, where the engineer has assisted the river in its reclamation work; this portion of the river is unbeautiful, and awaits "improvements."

The wide plains to the northward have been built up of alluvial waste brought down by the Gawler and Light Rivers into a gulf already shallower than that off the Port River Estuary. On account of the southward plunge of the underlying fault blocks, the building of the alluvial plains was slower in the area mapped in fig. 10. The formation of these plains was aided, as already shown, by the building up of a long north-running sand-spit from the cliffy area of bedrock at Seacliff. Where the sand-spit approached the bulge of the northern alluvial plains, a wide estuary mouth was left unfilled, and it is still in the process of being silted up. These facts, dealt with more fully in a previous section, help to explain the existence and character of the estuary.

It is of interest to note that an almost similar feature forms the harbour of Port Pirie—the second port of South Australia. Port Pirie is situated on a northward-pointing creek, an ancient and deserted estuary, on the flat eastern shore of Spencer Gulf. There is a deltaic plain, backed by the Flinders Horst, making the parallel with the conditions of Adelaide more notable. The Pirie Creek was the old estuary of the Broughton River, which

now enters the sea at a more southern point on its deltaic plain, but which occasionally, at flood times, overflows into the Port Pirie Creek.

The second feature of the Port River Estuary to which attention has been directed is that it is an "outsize," that is, it appears too large for the present contributing streams. This may be explained by the fact that three of the main streams that went to form the estuary, namely, the Torrens, The Sturt, and Brownhill Creek, have been diverted therefrom in whole or in part, as described in Section VII (b).

The Sturt and Brownhill Creeks have been wholly diverted, and their floodwaters now flow into the Patawalonga, or percolate into the lower plains, or evaporate from the wide areas of swamps that they now form in winter. The partial diversion of the Torrens has led to the discharge into the Port River of only a portion of its waters. A comparison of figs. 9 and 10 should assist in illustrating this point.

The third feature of the estuary is the comparative absence of silt from the Port River—a most desirable feature. The small amount of silt deposited is shown by the fact that the total cost of dredging the river is only £1,000 per annum (Parliamentary Paper 35/25), which is remarkably low compared with the thousands of pounds spent annually in dredging, say, the Yarra River, Victoria.

When Colonel Light first entered the long-sought harbour of the Port River he noted the clearness of the water, and also that the "habit of growth" of the weeds on the bottom was to point down stream. Thence he concluded that the ebb was habitually stronger than the flow, and consequently that there was a complement of river water entering the harbour. This proved correct. The added water is that of the Torrens.

Fortunately for the harbour of Port Adelaide, and unfortunately for the dwellers at Henley Beach, the Grange, and the lower deltaic plain, the last diversion of the Torrens has led to the deposition of its considerable burden of silt on the plains and swamps east of those sand dune townships. Thus they have the misfortune to suffer from an annual floodwaters problem, while Port Adelaide has the advantage of an increment of river water without silt. Indeed, it is this latter factor, acting through some thousands of years, that has provided the harbour facilities which this State enjoys.

It may be pointed out that the Little Para and Dry Creek also bring down their burdens of silt. Fortunately this is either deposited on the lower deltaic plain, or carried into the eastern arm of the estuary, the so called "Shallow Reach." A somewhat puzzling feature is the hook-shaped turn of the Port River that forms Light's Passage. It is puzzling because there is clear evidence that the Torrens and associated streams have discharged northwards for uncounted thousands of years, and now, with no evidence whatever of any change of wind or tide or current, the river has taken a southward trend.

The only explanation that appears to fit the circumstances is that the deposition of silt in "Shallow Reach" has led to the building up of Torrens Island, and to its somewhat western-pointing continuation northwards (Point Grey). The water of the Port River, in its daily ebbs and flows, has been diverted to the west by this bank of sand, and as is the custom of rivers under such conditions, the curvature has tended to continue, first from Snapper Point to Pelican Point, and then almost southward, forming Light's Passage. This development has been availed of and assisted by the building of Outer Harbour, and is still slowly continuing, as may be seen from a comparison of Light's chart of this locality with later more complete maps of varying dates.

The Wonga Shoal, a few miles to the southward, off Semaphore (see fig. 11), is an underwater feature that must greatly affect the future of the beaches at Semaphore and Largs, and also the channel of the Outer Harbour. It is clearly, from the evidence of its conformation, due to the diverting influence of the western bulge of the coastline at Point Malcolm. The continued building up of the Wonga Shoal may ultimately direct the channel of the Port River once more to the west, and lead to a continuation of the shallowing of the sea between the Shoal and Outer Harbour.

The pear-shaped Torrens Island, with its curving northern "stem," is a study in itself, physiographically and botanically. The western portion, consisting of old sand dunes, is the most desirable portion. The site of the Quarantine Station, with its casuarinas, native pines, and wealth of golden wattle, presents a glorious picture in the early Spring. The eastern portion of the island is an area of low samphire swamps, "hooked creeks," and winding "thoroughfares" of water. A combination of spring tides, westerly winds, and river floods leads to the almost complete inundation of this portion of the island.

This completes the physiographic survey of the Port River Estuary. The economic aspects of the various facts have been pointed out, and we have seen how wind and tide and river have conspired to build up a harbour that is, to say the least, a satisfactory one, and one that so high an authority as Sir Geo. Buchanan has stated may be converted with remarkable cheapness into a continuous series of seven miles of wharves from the present Outer Harbour, round the head of LeFevre's Peninsula, and down the western side of the Port River, to Port Adelaide. The land itself is of little value at present, and is utilised for rifle ranges or left untouched; if reserved, it must ultimately become a valuable asset. The vegetation is of mangroves along the river frontages, *Acacia ligulata* and spinifex on the sandy areas, with samphire flats behind.

VIII.—THE TORRENS TRIBUTARIES AND ASSOCIATED STREAMS.

(a) *Torrens Tributaries.*—It is not necessary to describe these features at length, except where they provide special evidence regarding the general physiography of the area or are themselves of geographic interest. Apart from the courses of these tributaries on the deltaic plains, which have already been described [Section VII. (d.)], there are two main types: Those that belong to the upper valleys east of the Mount Lofty Block, and which are more mature in their valley slopes and in their grades (see figs. 5 and 9), and those that originated along scarp faces.

The Upper Sturt River and Sixth Creek belong to a third type, formed by headward erosion along somewhat less resistant beds, behind the western fault blocks and parallel thereto. In the tributaries, as in the main streams, the controlling factor has been the tectonic fault-and-tilt movements, with capture, differential rock resistance, and possible inheritance of earlier routes as secondary factors. The Torrens tributaries are as follow, and the account is illustrated by the profile of the stream grades that is included in fig. 9:—

(i.) Sturt River.—The Sturt rises in the main Mount Lofty knot and has carved a deep valley in the ancient tillites and other rocks; the tillites give rise to rugged and characteristic valley slopes. The upper portion of the river, which includes the charming Coromandel Valley and the picturesque and more mature tributaries of National Park, assists in providing a route for both road and railway. The vigorous headward erosion, due to maximum

elevation and rainfall, has given this stream power to cut back into the Mount Lofty Scarp face, to the north of Cherry Gardens.

There is evidence in favour of the theory that the Sturt originally flowed down the tectonic valley formed by the Sturt and Belair Blocks, and flowed into Hallett's Creek (Happy Valley). The evidence consists of the characteristic elbow bend and gorge north of Flagstaff Hill, with a low gap and sands at the head of Happy Valley. Thus the Sturt is led through the scarp face to the west, in an area that will always be noted for its geographical and historical interest as the site of the first definite discovery of Cambrian glaciation [Professor Howchin, 1900 (1901)]. The course of the Sturt across the alluvial plain to the Patawalonga, and its probable one-time continuation northward to the Port River, have been described in Section VII. (c).

(ii.) Brownhill Creek.—This is a small tributary, heading back into the Mount Lofty Fault Block, and heavily dissecting the Sturt and Belair Blocks. It was at one time a favoured site as a railway route, but is no longer considered. As in all the scarp-face streams, the rainfall is high, the grade is steep, and the percentage and rapidity of run-off combined with the diminishing size of the channel in the plains, lead to floods along the lower reaches of this stream on the occasion of heavy rains. The lower portion of the scarp-face valley has been reserved as a park.

It should be mentioned that Nature has here placed ready to hand, for young students of physiography, a most remarkable laboratory. Each one of the scores of valleys in the scarp face near Adelaide presents a special and independent study of the influence of grade, rock types, rock structures, etc., on the work of streams. The writer does not know one of these numerous valleys that does not present special features quite distinct from those of the neighbouring streams.

(iii.) First to Fifth Creeks.—These five streams are characteristic scarp-face streams, with high grades, waterfalls, steep-sided and sometimes precipitous valleys above the fault scarp, and gently graded channels in fan deltas and alluvial plains below the scarp. The distinction in character between these two portions of the streams is so great that it has received popular recognition in the fact that most streams have names in the hills distinct from those they have on the plain.

Another interesting fact of nomenclature, illustrating a physiographic influence, is that the streams on the plains had originally the distinctive names set out below, but the channels were apparently so confusing because of their similarity that they came to be called by the more prosaic titles of mere numbers. The names referred to are:—

Present name on the plain tract.	Name used in the hill tract.	Name used in 1841.
First Creek	Waterfall Gully	Greenhill Rivulet
Second Creek	Slapes Gully	Hallett Rivulet
Third Creek	Horsnells Gully	Todd Rivulet
Fourth Creek	Morialta (Sinclairs Gully)	Anstey Rivulet
Fifth Creek	Montacute Creek	Ormsby Rivulet

The remarks made *re* Brownhill Creek apply here. The streams are accidental and not genetic tributaries of the Torrens. Each one of them is a distinct unit and has special characters and beauties of its own. There is, for instance, the remarkable contrast between the green open slopes of Waterfall Gully and the precipitous timbered gorge of Slapes Gully. Again, at Morialta, we have the influence of three bands of almost level-bedded quartzites, giving rise to three separate waterfalls, and there is evidence of a mosaic of blocks here—in one place an abrupt quartzite anticline faces a series of almost level-bedded calcareous and siliceous rocks.

Reference has been made to the variety in the native vegetation on the slopes of these scarp-face valleys; where quartzite predominates there is rough, low native scrub of xerophilous type, on the limestones there are park-like areas of grass-land with sparse red-gums. The introduced vegetation, that gives still further variety and beauty to the lower slopes, consists mainly of the Mediterranean suite of olives, vines, etc. These valleys constitute, as already stated, a ready-made and conveniently-situated laboratory for the study of river action.

(iv.) Sixth Creek.—This is the largest and most important tributary of the Torrens. It rises in the Mount Lofty Fault Block, near its highest portion, and flows northward, entering the Torrens in the Gorge Tract. It is separated from the more mature south-flowing Onkaparinga by Forest Range—a fact that supports the idea that Forest Range is the western scarp of a separate minor fault block within the main Mount Lofty Block.

The Sixth Creek is a good catchment area, and is also the site of fertile valley bottoms and of farming and gardening villages that harmonize with their surroundings in the charming way that is characteristic of the older townships in the hills. In its lower parts the valley is rugged and precipitous, but it tends to be more mature in the headwaters, which accords with the theory of rejuvenation by the more recent uplift of the Mount Lofty Block.

(v.) Upper Tributaries.—The tributaries of the Torrens from Chain of Ponds and Cudlee Creek upwards are harmonious in type with the more mature character of this portion of the valley. It may be noted, however, that the streams on the northern side are, on the whole, more gently graded than those on the south. The Chain of Ponds has less fall than Cudlee Creek; Forreston Creek bears similar relations to Kenton Valley. This is a difficult matter to explain, but it is possibly associated with the greater uplift of the whole horst to the southward. There are other peculiar features that await explanation, such as the relatively more mature character of the eastern slopes of certain streams, such as Howard Creek.

(b) *Associated Streams.*—The remaining streams that directly influence the Adelaide area have already been frequently referred to in the course of this paper. Considering them from north to south, we have the *(i.)* Little Para River; *(ii.)* Dry Creek; *(iii.)* Onkaparinga River.

(i.) Little Para River.—This has little bearing on the Adelaide area except that it is one of the streams that contribute to the Port River Estuary. The river appears in parts to be an ante-consequent, though the writer has much difficulty in deciding to what extent the effects of capture may be mistaken for evidences of antecedence. Certainly the dominant influence in this valley has been the faulting and tilting. The stream flows west from the Mount Gawler Range, which is the northern continuation of the Mount Lofty Scarp, across the remaining western fault blocks.

Where the valley cuts the fault scarps, sudden and precipitous gorges occur. The upper portions of the valley show a somewhat remarkable drainage network that appears to be due to the influence of differential resistance of varying rock types striking north and south. To the west of the Para Fault this stream has spread out a large fan delta, the site of the village of Salisbury—the northern continuation of the "higher deltaic plain" of the Adelaide area (fig. 4).

(ii.) Dry Creek.—This is a small consequent stream flowing down the southern tilting face of the Para Block, receiving its main tributaries from the high scarp face to the east, and originally emptying into the Torrens River. It has been captured by the headward erosion of a small stream on the Para Scarp face, and thus led away by a shorter route to the estuary. The evidences

of capture in the wind-gap, elbow-bend, and gorge are well shown. The channel across the plains diminishes and disappears.

The stream, in time of flood, spreads out into a wide sheet of flowing water, and at other seasons is either as dry as its name indicates, or flows in a diminishing stream as the waters soak into the deep alluvial beds. In the 1841 map, elsewhere referred to, this creek is marked as "Dry in Summer," and this appears to have led to the present name. Cockburn records that it was previously called Montague Creek. In the Adelaide area it cannot be said that the term "dry in summer" denotes any peculiarity, for the climatic and soil conditions are such that this is the common characteristic of all small streams during the long, hot, dry months of the year.

(iii.) Onkaparinga River.—This valley has already been described in dealing with the various fault blocks. Howchin, Teale, Benson, and others (refs. 1, 13, 21) have discussed the physiographic problems presented by this stream, but the matter has not yet been fully solved. It is difficult to decide with any degree of certainty whether the Gorge at Noarlunga is due to capture by headward erosion, or to superimposition, though the latter theory has been favoured in previous sections of this paper. The support for the theory of superimposition comes mainly from the evidence presented by similar features on the Torrens and other rivers to the north.

In considering the physiographic history of these streams, and particularly of the Onkaparinga, much suggestive information may be obtained from the work of Professor C. A. Cotton on similar block-faulted areas in New Zealand. For instance, in his work on Block Mountains (ref. 5), he writes: "If, as in Otago, the deformation has produced longitudinal tectonic features—both true consequent and ante-consequent drainage will follow generally longitudinal courses, though perhaps breaking across here and there from one linear series of depressed areas to another. Antecedent drainage, on the other hand, may cross the longitudinal features diagonally or transversely."

One cannot escape the conviction in travelling along and across most parts of the Onkaparinga Valley that its main outlines are partly tectonic in origin—formed by the tilting of fault blocks, with modification by stream erosion to such an extent that the valley and hills in the upper portions, above Ambleside, have much of the appearance of physiographic maturity. As in the case of the Torrens, the possibilities of "exhumation" and later tilting must not be overlooked. At Oakbank, where the valley has mature outlines, is situated one of the State's most famous racecourses.

The importance of the Onkaparinga Valley to Adelaide is chiefly in its fertile, food-producing areas, and in its great value as one of the chief catchment areas for water supply. The valley has much scenic beauty, of which the peaceful farming localities and bush scenes of Ambleside present many aspects that have inspired and have in turn been preserved by the art of Hans Heysen, whose home is in this valley.

IX.—EFFECTS OF GEOGRAPHIC CONTROLS.

(a) *Adelaide in its Relation to the State.*—A study of the distribution of the population, either of the whole world or of any special area, brings into prominence the fact that such distribution is never uniform, but tends to concentrate in what are called "islands" of population (ref. 2, p. 415). This is as true in plains as in mountain areas, in forests as in open lands, and in fertile as in desert places. It is particularly true of new lands, and South Australia is no exception.

A study of the population of the State, or of the Commonwealth, will show that in this respect the Spencer-Vincent Sunkland represents such an "island" of population (see fig. 15). Within this larger "island" of people we see, also, a number of other island communities of varying sizes, from the isolated village of Iron Knob, through "railway towns," "wheat centres," and coastal ports, up to the larger towns such as the industrial and shipping centre of Port Pirie. The city of Adelaide is itself an island community of some 320,000 souls—a community of outstanding interest from the geographical point of view (see fig. 16).

The study of Adelaide as a capital, and of its inter-relations with the country areas on which it depends for its existence, is a separate problem, and can only be touched on here in a general way. Vaughan Cornish, in his study of great capitals, tells us that such cities represent Crossways, or Strongholds, or Storehouses. A different mode of assessment must be applied to the capitals of new countries. In such places capital cities do not necessarily occur as natural growths—as did Paris, Berlin, or London—but may be planned beforehand on sites carefully selected for the purpose (Washington, Canberra, Adelaide).

From a study of the character of the site and city of Adelaide, its people and their occupations, and its relation to the rest of the State, we see that it is really a Radiating Centre, the place from which settlement has spread in all directions, and from which the whole of the State is governed. It has become in turn a Market-place, where imports are received and distributed, and where the exports are accumulated and sent away. Further, since the climatic conditions and the general amenities of the city are particularly attractive, another important factor in city growth comes into play, which we may recognise by calling the city a Garden.

A study of the human geography of Adelaide thus leads to the conclusion that the city is all three: a Centre, a Market-place, and a Garden. Although we have found the word "centre" to be applicable, it will be noted that Adelaide has that "forward" position required of the capital of a State. In this case the city stands forward towards the chief seaport of the State—the Gateway to the Homelands, and the route towards the oversea markets.

In the preceding sections chief place has been given to consideration of the geological and physiographic conditions of the Adelaide area. We will proceed to discuss the climatic conditions, and then the population, the occupations, and finally the distribution of the metropolitan population in time and in area.

(b) *Climatic Conditions.*—The climatic conditions have been the subject of systematic record almost from the birth of the Province, and have been well described by various writers. A summary of the general conditions is all that is here required, and this is set out in the following tables and shown in graphic form in fig. 12.

Ratzel has said that "Every state is a bit of soil and humanity." Brunhes improves on this with the statement: "Every state is a bit of soil, a bit of humanity, and a bit of water." The enormous importance of water is particularly indicated by a geographic study of South Australia.

(i.) Rainfall and Evaporation.—The following table gives (a) the average monthly rainfall in inches at Adelaide from records covering the past 88 years, and (b) the average monthly evaporation from a free water surface at the same place, also expressed in inches:—

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	
(a)	.72	.72	1.03	1.75	2.78	3.12	2.64	2.51	2.06	1.74	1.15	1.00	— Total, 21.22
(b)	8.99	7.33	5.79	3.41	2.02	1.24	1.30	1.87	2.84	4.76	6.50	8.44	— Total, 54.49

These tables are shown graphically in fig. 12. The rainfall records indicate that the Adelaide area enjoys a relatively dry summer and a rainy winter, with a comparatively low total rainfall. This emphasises the importance, from the point of view of water supply, of the adjoining high ranges, with their higher rainfall.

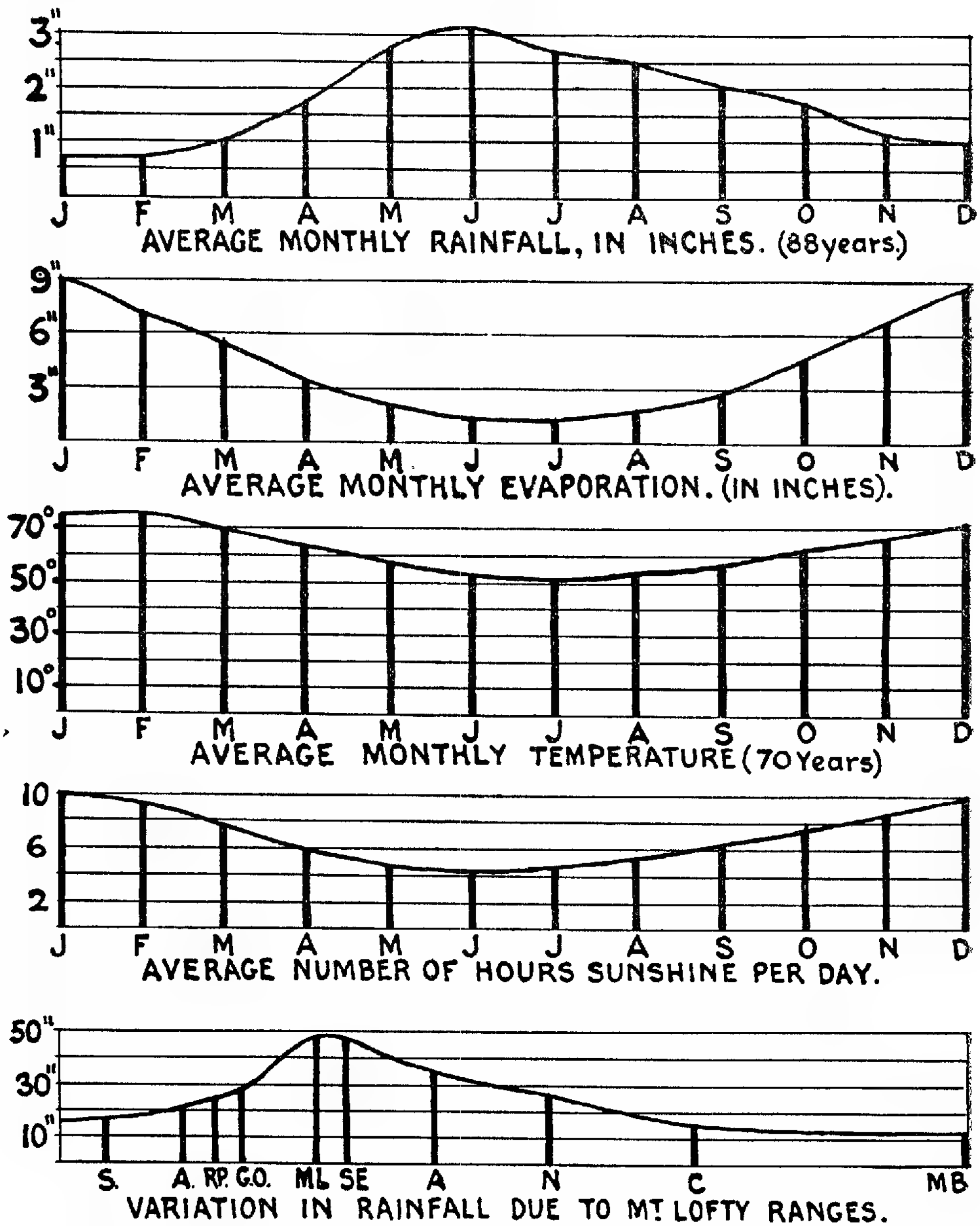


Fig. 12.

Graphs showing the average monthly rainfall, evaporation, temperature, and hours of sunshine per day; also the influence of the Mount Lofty Horst on the rainfall.

In the final analysis the limiting factor in the growth of Adelaide will probably be found to be the Water Supply. The evaporation figures further indicate the dryness of the climate, which possibly gives it a more exhilarating and enjoyable character.

The effect of the Mount Lofty Ranges on the rainfall has already been dealt with. The graph shown in fig. 12 emphasises the point, and shows, also, the very definite "rain shadow" that lies to the east of the ranges. The figures are as follow, in inches: Seaton, 17.29; Adelaide, 21.22; Rose Park, 25.97; Glen Osmond, 26.34; Mount Lofty Summit, 47.31; Stirling East, 47.20; Ambleside, 35.13; Nairne, 28.37; Callington, 15.48; Murray Bridge, 13.94.

(ii.) Sunshine and Temperature.—Adelaide has a remarkable share of sunny hours. The average monthly temperature, taken over a period of 77 years, in degrees, is shown at (a) and in fig. 12, while the average number of hours of sunshine per day is given at (b). From this will be seen the remarkably mild winter that the city area enjoys, and which is one of the chief charms. Even in June, July, and August there is a daily average of between four and five hours of sunshine. The summer, though hot, is dry, and is enjoyable to most people. When a continued "hot spell" occurs, relief is available at the seashore and in the adjoining cooler uplands.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	
(a)	73.9	74.1	69.8	64.0	57.9	53.5	51.8	53.9	57.1	61.9	67.0	71.1	—Tot. Av., 63.0
(b)	10.0	9.4	7.7	5.9	4.8	4.1	4.5	5.3	6.1	7.4	8.7	9.8	—Tot. Av., 7.0

(iii.) Winds and Tides.—Adelaide lies within those invigorating and energy-rich areas of the world (*vide* Huntington, "Climate and Civilization") where the weather is varied and is governed by a series of successive cyclones and anti-cyclones; at times monsoonal influences temporarily reach down from the northward.

The actual figures regarding the winds, to which reference has been made in the sections dealing with the growth of the sand-dune barrier and the estuary, are set out in the following table, which gives the average number of days in each month during which the wind has prevailed from various directions at Adelaide:—

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	Gales
January	1	2	3	4	7	7	3	1	3	2
February	1	2	3	5	6	5	2	1	3	1
March	1	2	3	5	6	6	3	1	4	1
April	3	4	3	3	4	5	3	2	3	1
May	5	6	2	2	3	4	3	3	3	1
June	6	6	2	1	2	4	3	3	3	1
July	6	6	2	2	3	4	3	3	2	2
August	5	6	2	1	2	4	5	4	2	2
September	3	5	2	2	3	6	4	3	2	3
October	2	4	3	2	4	7	5	2	2	2
November	1	3	3	3	5	8	4	1	2	1
December	1	2	3	4	5	8	4	1	3	2
Total for Year	35	48	31	34	50	68	42	25	32	19

It will be seen that the prevailing winds are S.-S.W. In dealing with the winds mention should be made of two sets of local winds that have important influences. One of these is the ordinary sequence of land and sea breezes that is particularly felt along the outer sand dune belt, and renders these areas so important to the city (see fig. 16).

The other is the so-called "Gully Winds," due to the downward drainage through the scarp-face valleys on to the plains in the late afternoon and evening (often far into the night) of the colder air of the highlands; they are cooling breezes, but in many cases they constitute a nuisance on account of

the damage done to gardens, etc.; these winds have a distinct influence against the progress of settlement towards certain localities of the piedmont area (see fig. 16).

The tides have little bearing on the geography, except in the important matter of the formation of the coastal features and the harbours. To the tides we owe the beautiful stretches of sea-beach, and the scouring of the Port River and Light's Passage. To them, also, we must attribute the Wonga Shoal, and its gradual and undesired extension to the north and west. The tides are briefly described by Professor Chapman (A.A.A.S. Handbook, 1924, p. 18).

The following data are from the "Australia Pilot," Vol. I., 1918: "It is high water, full and change, at the Semaphore Jetty at IX h. 40 m.; springs rise 7¾ feet, neaps 5 feet. During the summer months, at springs it is high water in the morning, and low in the afternoon; at neaps it is low in the morning and high in the afternoon, and the a.m. tides rise higher than the p.m. During the winter months the reverse of this is the case. Westerly winds raise the general level of the water 2 to 3 feet, easterly winds depress it about 1½ feet. The neap tides are very irregular. Five days before full and change, the tides cease to flow regularly; there is then a very small rise and fall; the first making tide of high water generally occurs from one to two o'clock on the following morning; the tides then run in their usual course to springs. This peculiarity of the tides is experienced in both St. Vincent and Spencer Gulfs."

(c) *Transport and Communications.*—The State of South Australia is a land of big distances. Adelaide being the administrative centre to a very thorough degree, and the chief market of the State, it is further necessary that abundant and rapid transport should be available. This takes the form of a widespread railway system and active coastal shipping. There is a remarkable development of ports in the Gulf Region, no less than 40 being listed in the Annual Report of the Harbours Board. There is, also, a radial system of roads, and in response to the rapid modern development of motor traffic the chief of these are being laid with bituminous concrete. The chief trunk roads from Adelaide, as laid down by the Commissioner of Highways, are set out in fig. 13.

The railways may be considered, from the geographical point of view, under three heads: (1) Those that leave Adelaide for the ports; (2) Those that leave the city towards the north; (3) Those that leave the city towards the south.

The railroads towards the ports, as already stated, lie mainly along the old course of the Torrens. They present no difficulties except when approaching and crossing the more recent deltaic mud areas of the Port River. The railway to the Inner Harbour is the oldest in the State, and was built in the face of much opposition; it lies parallel and close to the route set apart for a canal by the founders of Adelaide.

The northern railroads have before them the wide alluvial plains that are the northern continuation of the Adelaide Plains, or they enter the area of the ranges across low divides, and run up the long north-south alluvial plains that are characteristic of that portion of the State. One route crosses the ranges *via* Kapunda and Eudunda to Morgan, but is of more value as a "local" line than as one tapping the Murray Basin, for reasons already given.

The railroads leaving the city towards the south must face at once the high barrier of the Mount Lofty Horst, and the problems thus presented have been dealt with in some detail in Section VI. (o). There are no less than two railway routes to the seaside suburb of Glenelg, but these are of little economic importance.

The trunk roads form a geographic study in themselves, but can only be referred to in a general way. The physiographic influences that operate are quite similar to those of the railways, except that steep grades present to modern motor traffic much less of a barrier than they do to steam trains.

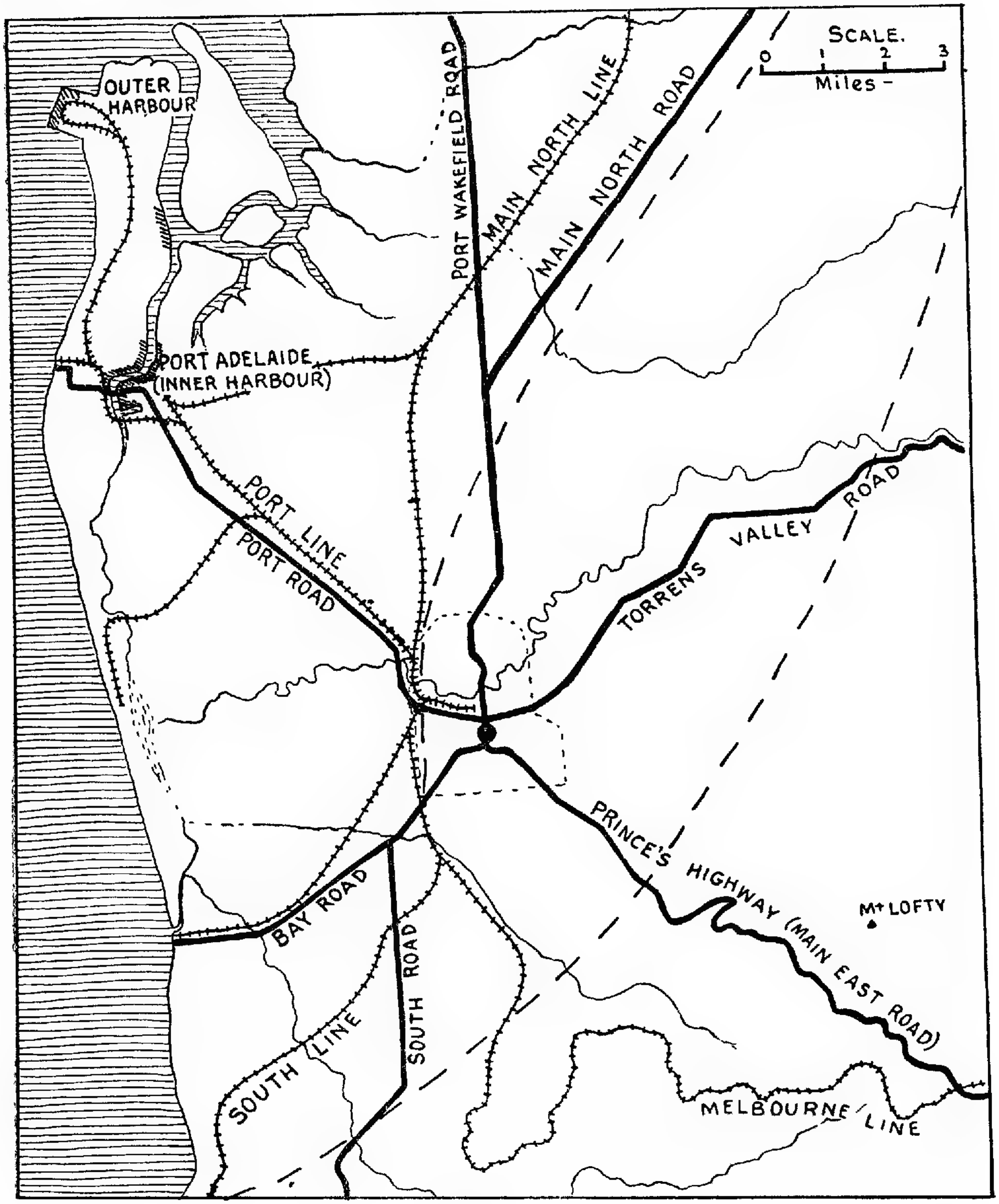


Fig. 13.
Plan showing the chief roads and railways radiating from the City of Adelaide.

The chief trunk roads, as shown in fig. 13, are: (1) The Port Road, lately duplicated; this is the most important single road in the State, and a review of its daily traffic provides an epitome of the commercial geography of

South Australia. (2) The North Road traverses the plains parallel to the Para Scarp, and bifurcates at Gepps Cross, one going to Port Wakefield and Yorke Peninsula, and the other to the main northern regions. (3) The Torrens Valley Road proceeds along the Torrens Gorge and opens up much of the hills country and the so-called "Murray Flats." (4) The "Prince's Highway," the main eastern route, climbs the scarp *via* the Glen Osmond Creek; it divides at Littlehampton, one branch going to Murray Bridge, and the other to Wellington, where there is a ferry, across which passes the bulk of the motor traffic to the South-East and to the Eastern States, *via* the Coorong. There is as yet no properly constructed trunk road connection between Adelaide and any other State capital. (5) The South Road caters for the Fleurieu Peninsula and Victor Harbour; it is largely a pleasure route. (6) The "Bay Road" leads to Glenelg (Holdfast Bay), and is at present the most important pleasure route in the State.

Numbers of other roads lead out from the city into the hills, and several are shown in fig. 16. It will be noted how straight are these radial routes from the city until they meet the fault scarp, up which they writhe more or less tortuously according to the height of the scarp at the place of ascent. Many of these are used purely as scenic and pleasure roads. In the hills themselves it is notable to what extent the scarp ridges are used for communications.

The electric tramway system, at present showing a tendency to merge into a more mobile motor-bus system, is set out in fig. 16. Owing to the open level character of the city site, coupled with wise engineering direction, a comprehensive radial system has been devised for the city, with a smaller separate system at Port Adelaide. The influence on these lines of the various physiographic features described in the preceding sections needs no elaboration.

In an account of the system of transport in operation, tendencies are perhaps more important than established facts. In this connection mention must be made of the growing importance of motor-borne traffic, and also of the initiation of aerial services. The air service is at present in its infancy; the site of the aerodrome is on the lower deltaic plain at Albert Park, whence passengers and mails leave for Mildura, Broken Hill, Melbourne, and Sydney.

(d) *The Growth of the City Population.*—A matter that is frequenty discussed, and on which no final decision has been reached, is the merit, or otherwise, of the growth of the metropolitan population relative to that of the country. While regarded by some as a retrograde movement, others see therein the signs of progress. Whichever may be the correct view, the tendency is a very decided one and an accelerating one, as may be noted from an inspection of the graph shown in fig. 14, particularly in the portion representing the post-war years.

In fig. 14 is shown the relative growth of the city and country population from the earliest years of the State, the figures being kindly supplied by the Government Statist, Mr. W. L. Johnston. The firm line (marked "City") represents the total population of the metropolitan area (within a 10-mile radius of the G.P.O., Adelaide), and the broken line (marked "Country") represents the total population of the State outside of the metropolitan area.

It will be seen that for the first 15 years the population of city and country ran closely parallel. The country population then increased rapidly, while the city expanded but slowly. By 1864 the country population was twice that of the metropolitan district. The country continued to progress more rapidly than the city, as far as population increase was concerned, up to 1876, when city growth began to be more marked.

About 1890 the population of the country received a set-back; during that year there took place the first recorded decrease in country population,

accompanied by an increase in the city. Since that date the variations in the country population have been marked, the effects of droughts and war being most pronounced. During the same time, apart from the decrease of the war years, the city has progressed in numbers at a rapid rate—much more so since 1910.

By the year 1913 the city and the country populations were equal. Since then the relative rates of increase, shown on the graph (fig. 14), have been so distinct that by 1926 the city population was 316,865, and the country only 249,529—that is to say, the extra-metropolitan or country population was little more than three-quarters as great as that of the metropolitan area.

This does not appear to be due to geographic controls, except insofar as the city area is a most desirable one in which to live. The chief factors that are operating in the matter might be: (1) An increased desire for the com-

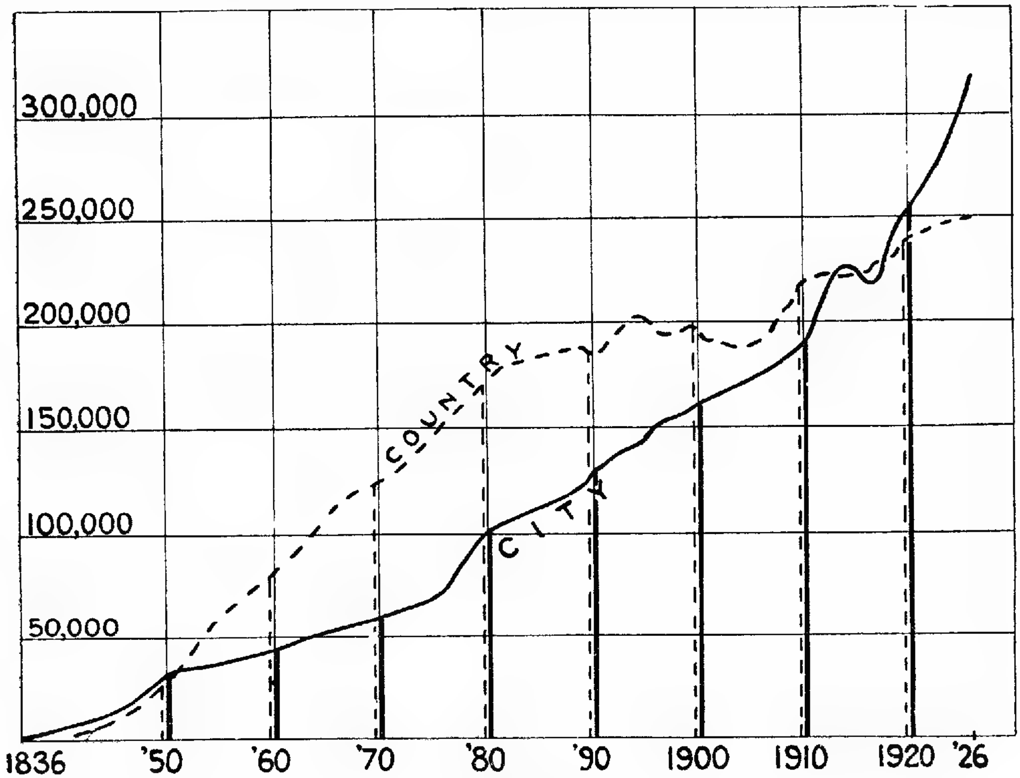


Fig. 14.

Graph showing the relative population of Adelaide and the country districts, from the birth of the Province up to the year 1926.

forts and conveniences associated with city and suburban life; (2) higher rates of pay for city industries; and (3) increased mechanical aids, whereby fewer people than heretofore are required to work the land. Possibly the most interesting feature of fig. 14 is the prophecy of the future that is shown by the trend of the graph lines of the city and country respectively for the past six years. If the present rates of increase continue unchanged until 1940, the city population will be about 450,000, compared with 275,000 in the country.

(e) *The Occupations of the People.*—In the opening paragraphs of this section Adelaide was described as a Centre, a Market, and a Garden. The first

characteristic is shown by the number of people employed in administrative work, the second by the high proportion of those engaged in buying and selling (commercial callings), while the third is indicated in part by the number of independent people who have preferred to live in the area, and in part by a very well-known tendency for families to move to Adelaide from the country areas—a movement for which no definite figures are available.

In the fourth place, the metropolitan area is becoming, to some extent, a manufacturing city, but the absence of local supplies of coal, water-power, iron, and timber must always militate against any considerable development of manufacturing. Following along the lines of argument of the eminent geographer, Ellsworth Huntington, it might be argued that Adelaide owes much of the part that it plays in the industrial life of Australia to its pleasant climate and good conditions of housing and living—geographical factors which Huntington asserts to be associated with comparative freedom from what are called "labour troubles."

In 1921 census figures show that—of a total population of 255,000—149,000 were "dependents" (non-wage earners). Of these, 80,000 were under 20 years of age. Of a total of 80,000 male bread-winners, the following were the chief occupations:—

Industrial	35,000
Commercial	19,000
Transport and Communication	10,000
Primary Producers	7,000
Professional	6,000
Domestic	2,000

There were also 26,000 female bread-winners, the majority engaged in domestic, commercial and factory work. The number of people in actual manufacture is slowly increasing, having risen from 88 per thousand in 1914 to 95 per 1,000 in 1926.

From a further analysis of industrial occupations, taken from the 1926 report of the Chief Inspector of Factories, we learn that the chief industries are local, and have to do with the all-important matters of clothing, shelter, nourishment, and movement. That is to say, they are mainly associated with building houses, making furniture, making clothes and boots, and preparing food.

The only other important industry is that associated with the building and repairing of carriages and motors. The making of agricultural machinery—the only really "productive" branch of manufacture—is somewhat low on the list. A high proportion of workers is engaged in land and sea transport, and in the handling of goods. A great body of less skilled labour is also engaged building and maintaining roads, railways, pavements, drains, etc. The details of these figures tend to confirm the conclusion that Adelaide is an Administrative Centre, a Market-place, and a Gateway.

(f) *The Distribution of Population in the Adelaide Area.*—Reference was made in the opening sections to the importance of the Gulf Region to South Australia. The Spencer-Vincent Sunkland may be said to constitute the "fertile island" that is the chief part of the State. There are also four important sub-provinces: (1) The Eyre Peninsula area; (2) The Murray River Valley; (3) The Murray Mallee; (4) The South-East. In addition, continual progress is being made towards the settlement and utilisation of the drier northern portions of the State.

The distribution of the population of the Gulf Region is shown by a spot map in fig. 15. Each small dot represents approximately 100 people. The large black area represents the Adelaide Region on its triangular alluvial

plain, further detailed in fig. 16. In the general distribution of the population rainfall is the dominant factor.

The influence of existing supplies of water on the sites of early townships is shown by the place names: in some cases by the English name as in Two Wells, Crystal Brook, Butcher's Soak, Nangula Springs, Claypans Bore, Bagots Well, etc.; in other cases by the large number of aboriginal place names ending in words that mean "water," chief of which are (from information courteously supplied by Mr. Rodney Cockburn) those ending in -owie, -cowie, -appa, -apa, -kapi, -ana (Terowie, Yarcowie, Nalyappa, Puttapa, Poontana, Yabmana, etc.)

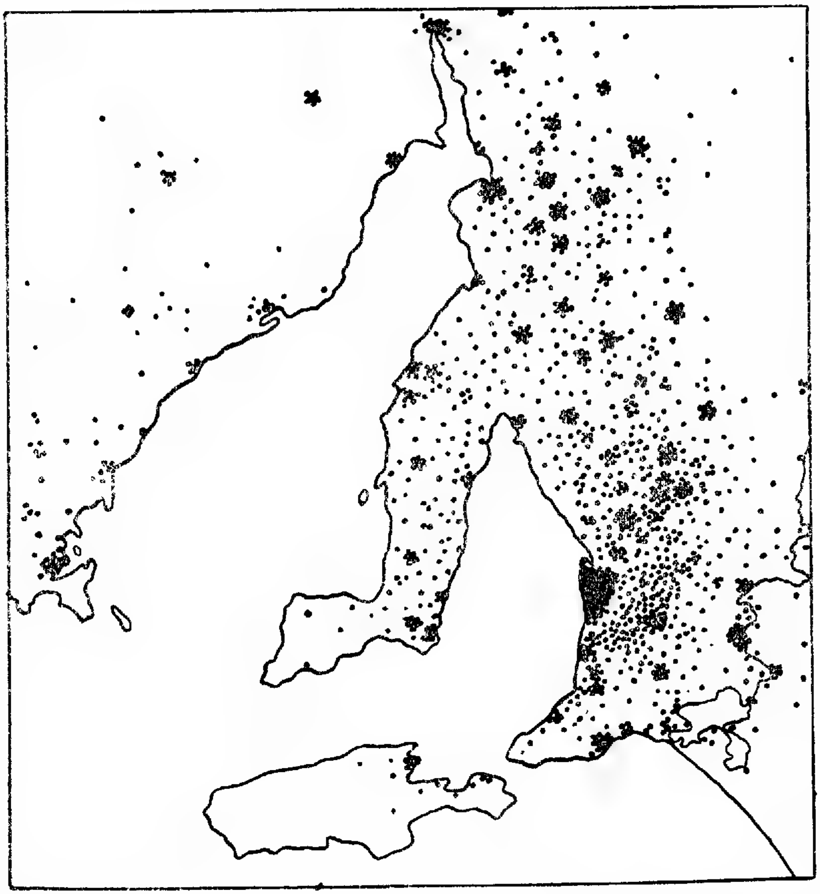


Fig. 15.

Spot map of the Gulf Region, the same area as is shown in fig. 3. Each small dot represents approximately 100 people; the larger dots represent denser "islands" of population.

The chief islets of population in the extra-metropolitan districts are due to smelting works (Port Pirie); gulf ports (Port Lincoln, Port Augusta, Wallaroo, Whyalla, Edithburgh); river ports (Murray Bridge); pleasure resorts (Victor Harbour, Kingscote); railway towns (Peterborough, etc.); agricultural centres (Gawler, Quorn, Melrose, Mount Barker, Minlaton, Kapunda, Strathalbyn, etc.); irrigation settlements (Renmark, Berri, Waikerie, etc.).

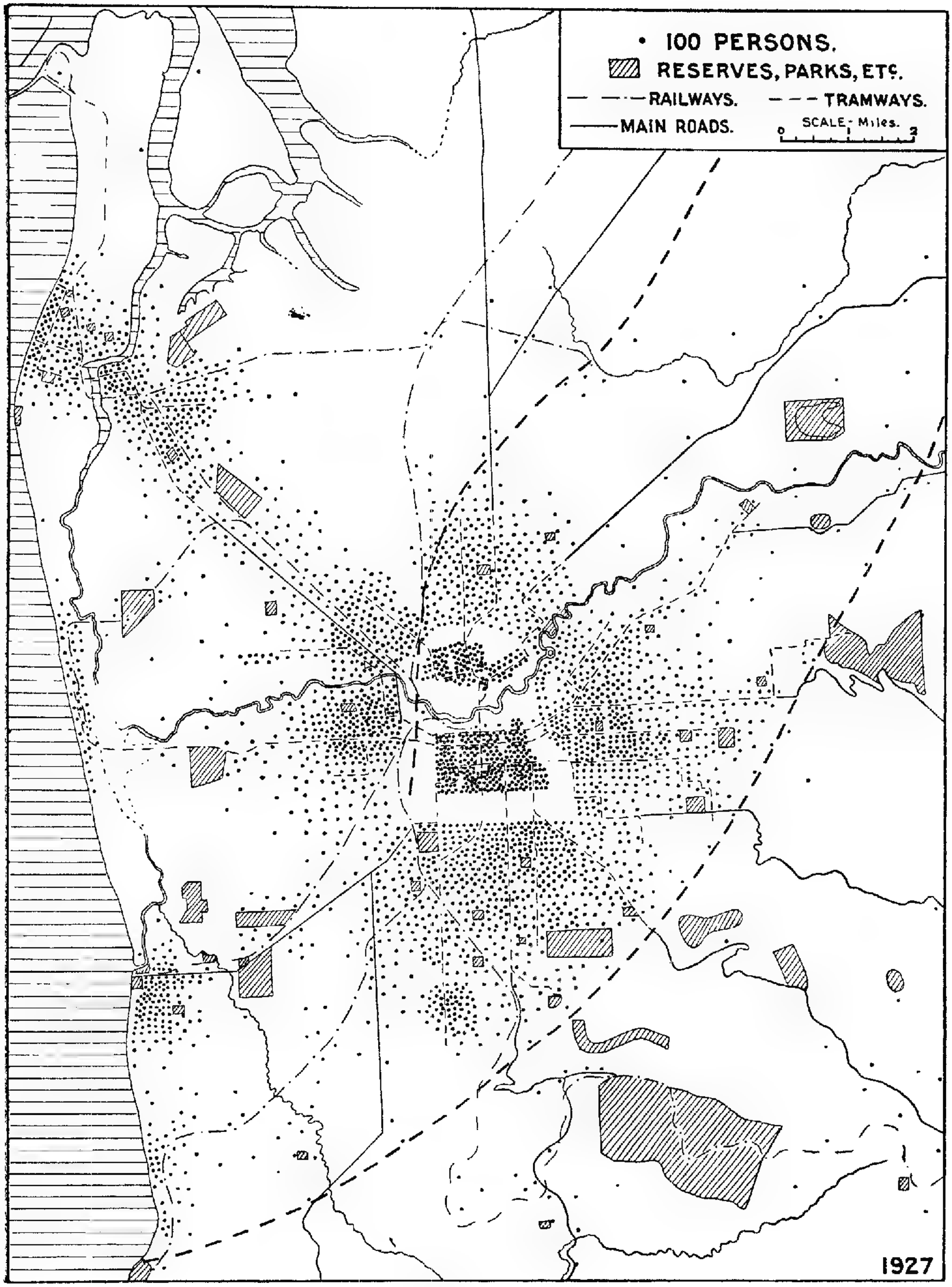


Fig. 16.

Spot map of the Adelaide Region. Each small dot represents approximately 100 people. Parks and sports reserves are shaded; they occur mostly along the high-land front and on the lower deltaic plain; the City "Park Lands" stand out prominently. The tramlines, roads, and railways are indicated. This map should be read in conjunction with fig. 4.

The most thickly populated country areas are the orchard, vine, and garden districts of the western portion of the central Mount Lofty Ranges. The dairying areas of the Murray "swamps" are growing in importance, while the iron-mining and salt-producing localities also have their islets of humanity.

The distribution of the population within the Adelaide area is shown in fig. 16. This has been compiled from the latest available figures. The choice of a dot unit of 100 persons is quite suitable for the chief city and suburban areas. Since each dot represents 20-30 families, however, it does not properly represent the facts in the more sparsely settled farming and gardening localities.

Notwithstanding this fact, the whole map gives a reliable general picture of the distribution of the population of Adelaide at the present time. While taking advantage of all the available information from statistical and municipal sources, the draftsman (Mr. J. A. Tillett) and myself have made personal inspections in localities less well known to us, have studied aeroplane photographs of various portions, and have viewed and noted the city growth from various vantage points on the scarp face.

The only other plan of the Adelaide area known to me that in any way approximates to a "spot map" is that drawn by G. S. Kingston in 1842, to show the distribution of the houses in Adelaide. At that time the population of the State was almost 15,000. This shows in the city area concentration towards water supplies in both North and South Adelaide, with a secondary factor of nearness to the Port Road in South Adelaide. It is noticeable, as a minor feature, how settlement in those days avoided the "lonely" spaces of the six public squares of the city.

The population map (fig. 16) throws into high relief the Park Lands of the City of Adelaide, which were set aside as reserves in the very first plans of the city. On this figure there has also been included all the more important parks, reserves, and sports grounds of the area. It will be noted that parks and reserves, here as elsewhere, abound on the less valuable spaces—in this case on the hills and valleys of the scarp front, and along the swampy lower deltaic plains. Along the latter may be seen a row of racecourses, golf links, coursing reserves, and rifle ranges. The golf links have excellent positions, for the most part on the relics of the old sand dune belt.

It will be noted that there are as yet no outer sand dune reserves nor any such space set aside on Le Fevres Peninsula, apart from the tiny area of old lagoon (now being reclaimed) adjoining Hart Street, and a small semi-official reserve at Outer Harbour. The chief National Parks are as follow: National Park, Belair, 2,000 acres (the old "Government Farm"); Morialta, 525 acres; Waterfall Gully, 103 acres; Hazelwood Park, 30 acres; Brownhill Creek, 142 acres; Mount Lofty Summit Reserve, 60 acres; Kingston Park, 20 acres.

The detailed distribution of population as shown in the figure must be studied in conjunction with the whole of the foregoing sections, and more particularly with the physiographic zones (fig. 4) and the climatic factors. Thus we see how the Para Fault Block carries by far the greatest portion of the population. Apart from the shoreline itself, no physical factor exerts greater influence than the Para Scarp and the main Mount Lofty Scarp. The great bulk of the population lives to the east of the Para Scarp and west of the Mount Lofty Scarp; there is no need to elaborate this in view of the facts revealed by the map.

The influence of the outer sand dune belt has been frequently referred to; even the municipalities along this zone have elongated north-south outlines. Note the four "islands" of sand dune population: (1) Brighton, (2) Glenelg, (3) Henley-Grange, (4) Semaphore-Largs.

The repelling effect of the lowlands of the estuary is distinctly seen, though the clustered population of Port Adelaide on this area shows that even so powerful a geographic factor may be overcome by the influence of nearness to the port. Between the outer sand dune belt and the higher deltaic plain is the almost unpeopled belt of lower deltaic plain (compare figs. 4 and 16), which is subject to floods.

The geographic influence of the Port Line and Road, which, it must be remembered, largely lie along the old fan delta of the Torrens, breaks the continuity of the unpeopled lower delta. The higher deltaic plain, particularly where the old fan delta of the Torrens is highest, is thickly populated: Hilton, Mile End, Thebarton, Bowden, Hindmarsh, and the associated suburbs.

The city of Adelaide itself remains the most densely-populated portion of the area as shown by fig. 16. There is a distinct tendency nowadays for the city population to move out to the suburbs, partly due to the desire for larger allotments and more modern cottages, aided by the need for additional space within the city for motor garages, factories, and shops, as well as by modern means for rapid transport. Everywhere old tenement houses are being replaced by industrial buildings. The foundation of the garden suburb of Colonel Light Gardens, the population of which forms a notable "islet" to the south of the city (see fig. 16), may be correlated with this tendency to move outwards from the more congested parts of the city.

On the higher land of the Para Block Adelaide stands within its belt of parks, with its northern continuation (Prospect and Nailsworth), its eastern continuation (Norwood, Kensington, and Burnside), and its southern extension (Goodwood, Unley, and Parkside). Along the Torrens Valley we have the denser areas of Walkerville, St. Peters, and Payneham. The density of population falls off as the foothills are approached to the east, and stops at the main scarp front almost as completely as it does at the shoreline on the west.

This completes the survey of the human geography of Adelaide. We have endeavoured to show that the city resembles a great single organism, growing and expanding, or decaying and retreating, according to the geographical factors of land and water, height and distance, warmth and water supply, food and recreation. We have seen in fig. 16, how the city reaches out towards the desirable or necessary areas, and how it shrinks from those geographically undesirable. Finally, we have seen the city as an "island" of population, mutually co-operating with the great productive country areas on which it is dependent, and for which it constitutes a Market, a Gateway, and a Garden.

X.—LIST OF REFERENCES.

1. W. N. Benson—"Notes Descriptive of a Stereogram of the Mount Lofty Ranges." Trans. Roy. Soc. S. Austr., vol. xxxv., 1911, p. 108.
2. Vidal de la Blache—"Principles of Human Geography." London, 1926.
3. Jean Brunhes—"Human Geography." London, 1912.
4. Vaughan Cornish—"The Great Capitals." London, 1923.
5. C. A. Cotton—"Block Mountains in New Zealand." American Journal of Science, vol. xliv., Oct., 1917, p. 249.
6. C. A. Cotton—"Fault Coasts in New Zealand." Geographical Review, vol. i., 1916, No. 1, p. 20.
7. W. M. Davis—"Geographical Essays." Boston, 1909.

8. Charles Fenner—"The Physiography of the Adelaide Region." A.A.A.S. Handbook, Adelaide, 1924, p. 12.

9. Charles Fenner—"The Physiography of the Werribee River Area." Proc. Roy. Soc. Vict., vol. xxxi., Dec., 1918, p. 176.

10. Charles Fenner—"The Physiography of Victoria." Proc. Pan-Pacific Science Cong., 1923, vol. i., p. 719.

11. Walter Howchin—"Geology of South Australia." Adelaide, 1918.

12. Walter Howchin—"The Evolution of the Physiographical Features of South Australila." A.A.A.S., vol. xiv., Melbourne, 1913, p. 148.

13. Walter Howchin and J. W. Gregory—"Geography of South Australia." Adelaide, 1909.

14. Douglas Mawson—"Notes on the Geological Features of the Meadows Valley." Trans. Roy. Soc. S. Austr., vol. xlvii., 1923, p. 371.

15. A. Grenfell Price—"The Foundation and Settlement of South Australia." Adelaide, 1924.

16. A. Grenfell Price—"The Settlement of South Australia." A.A.A.S., vol. xvii., Adelaide, 1924, p. 439.

17. A. Grenfell Price—"Geographical Problems of Early South Australia." Proc. Roy. Geog. Soc. S. Austr., vol. xxv., 1925, p. 57.

18. Griffith Taylor—"Physiography of Eastern Australia." Com. Bur. of Meteorology, Bull. No. 8, Melbourne, 1911.

19. Griffith Taylor—"The Australian Environment." Advisory Council of Science and Industry, Memoir No. 1, Melbourne, 1918, p. 96.

20. E. O. Teale—"Forest Physiography of Kuitpo." Bull. No. 6, Dept. of Forestry, Univ. of Adelaide, 1918.

21. E. O. Teale—"The Physiography of the Meadows Valley." Trans. Roy. Soc. S. Austr., vol. xlvi., 1922, p. 160.

CHIEF MAPS AND PLANS CONSULTED.

H. Y. L. Brown—Geological Map of South Australia, 1899.

L. K. Ward—Geological, Topographical, and Water Supply Maps of South Australia, 1913, 1917.

Surveyor-General Strawbridge—Topographical Map of the Hills District, circa 1897.

W. H. Edmunds—Topographical Maps of Adelaide Hills, 1926.

Com. Military Survey—Adelaide Sheet, with Contours, etc., 1914.

J. A. Tillett—M.S. Map of Adelaide Plains, 10′ V.I., prepared from data on the Hydraulic Engineer's large scale plans, 2′ V.I., 1926.

Admiralty Chart—Spencer and St. Vincent Gulfs, No. 2,389.

Parliamentary Papers—River, Railway, Bridge, and Harbour Plans, etc., 1870-80, 1917, 1921-22.

Maps, Plans, etc., kindly made available by Dr. L. K. Ward (Director of Mines), Mr. T. E. Day (Surveyor-General), Mr. H. E. Bellamy (Hydraulic Engineer), Mr. J. T. Furner (Engineer for Surveys), Mr. D. V. Fleming (Commissioner of Highways), Mr. R. G. Peake (Secretary, Harbours Board), Mr. F. L. Parker (Clerk, House of Assembly), Mr. W. L. Johnston (Government Statist), Mr. Shinkfield (Commonwealth Meteorological Bureau), Mr. G. H. Pitt (South Australian Archives), Mr. W. Scott Griffiths (Town Planner).

A REVISION OF THE "DISTYLA COMPLEX" OF THE GENUS CASUARINA.

By Ellen D. Macklin, B.Sc., Demonstrator in Botany, University of Adelaide.

[Read September 8, 1927.]

Plate XIII.

Contents.

I. Introduction.

Field observations and the examination of herbarium material have shown that there are seven species of *Casuarina* in Australia at the present time grouped under the name of *C. distyla*, Vent. With such confusion existing, it seemed as though a review of the species concerned would be useful. Since I had available six species of the "*Distyla* complex," all of which had been examined in the field, it was decided to attempt the necessary revision.

II. Historical Work.

Although the *Casuarinaceae* is a small family, composed of a single genus, *Casuarina*, containing relatively few species, there has always existed a great deal of confusion among those species. This, perhaps, is due, in the first place, to the fact that various botanists have described one or two species from time to time as opportunities have offered, while for nearly a century after the publication of the first description by Rumphius, no worker attempted a revision of the family. The natural consequence of this lack of co-ordinated work was that the same species was frequently described twice, or even three times, under different names. This accounts in some measure for the number of synonyms within the genus.

Progress in the knowledge of the flora of Australia during the last century demanded the specific determination of many *Casuarinas*, some of which were

very closely related. Now the family is unique in structure, and the characteristics which give it distinction are so constant that they have no value in determining individual species. Many of the earlier workers, with the smaller range of form available to them, could not realise this, and, consequently, one finds that points which appeared to be specific had little value at a later date when further exploration brought in more species. Thus some of the earlier descriptions were inadequate for the separation of the new forms, and so, as time went on, the nomenclature became more and more confused. There is much variation within the limits of any one species, while in some cases it is difficult to distinguish between mere variation and points of specific importance. Many of the species are so similar in general appearance that unless the systematist resorts to a detailed examination of the flower or the anatomy of the stem, it is difficult to see the boundaries of any one species, and consequently it will be seen that confusion is inevitable.

It is of interest to trace the history of the discovery of the species occurring in South Australia, and also some of those which have hitherto been recorded for the State.

For much of the following detail I am indebted to Miquel (1848), as many of the publications referred to are not available in Australia. Owing to the rarity of Miquel's work here, it has seemed useful to summarize the history of the genus.

Rumphius (1755) and the Forsters (1775) made the first contributions to our knowledge of the genus. About the same time as the work of the two Forsters was published, several species of *Casuarina* were introduced into European gardens. Among them was one which Aiton named *C. stricta* and described very briefly in the first edition of the *Hortus Kewensis*, 1789.

Ventenat, in 1803, described *C. distyla*, which had previously been brought from Tasmania, and was, at that time, growing in the celebrated *jardin du Cels*. Ventenat was uncertain whether the plant he described differed sufficiently from *C. stricta*, Ait., to receive specific rank. He remarks: "Il est impossible de déterminer d'après la seule phrase spécifique [1] qui se trouve dans l' *Hortus Kewensis*, si le *Casuarina distyla* est la même plante que le *Casuarina stricta*, ou si c'est une espèce différente."

Labillardière, in 1806, described *C. quadrivalvis* from material he had collected in Tasmania. Probably this species is the same as that described so inadequately in 1789 under the name of *C. stricta*. The complete description and excellent illustrations given by Labillardière leave no possibility of doubt that his species is identical with that known by the name of *C. stricta*, Ait., in this State to-day.

Following these publications came a period of activity in extra-Australian regions resulting in the collection and description of several new species.

In Sprengel's work (1826) descriptions of the species collected by Sieber, in Australia, occur; among others are *C. glauce*, Sieb., and *C. paludosa*, Sieb. It is unfortunate that Sprengel divided the thirteen species dealt with into two groups, according to whether they were dioecious or monoecious. These points are far from constant in the majority of species and are of no specific importance, so that the separation tended to obscure natural affinities.

In 1841 all the species growing in the Berlin Gardens were determined and described very accurately by Otto and Dietrich (1841). Among these were *C. suberosa*, *C. pumila*, and *C. humilis*.

The first worker to attempt a revision of all the known species was Miquel (1848), and it is to him that we owe the existence of careful illustrations and of complete and comprehensive descriptions. The first collection dealt with was

(1) *Vaginis multifidis.*

that made by Preiss in the vicinity of the Swan River (W.A.) and handed over to him by Lehmann for determination. The results of this examination are published in Lehmann's work (1844). Later other collections passed through Miquel's hands, and before he published his valuable revision, he examined Sir William Hooker's vast collection (which included plants found by Sieber, Baxter, Fraser, Sinclair, Cunningham, J. D. Hooker, and others), and all those plants growing at the time in the Berlin Gardens. The examination of these plants culminated in his Review (1848). The work contains complete descriptions and illustrations of about thirty species, and also a history of work on the family.

In 1859, Miquel described *C. Muelleriana* collected by Mueller in the Mount Lofty Ranges. In a later publication (1865) and in De Candolle's Prodromus he considered this species to be a variety of *C. suberosa*, with which it is more closely connected than it is with *C. distyla*, in which Mueller and Bentham merged it.

During the years 1864-1868, vol. 16 of De Candolle's great work was in preparation. To this Miquel contributed minute descriptions of the then known species of *Casuarina*, among which were *C. distyla*, Vent., *C. rigida*, Miq., and *C. Baxteriana*, Miq.

Botanical work was making great progress at this time in Australia, and in order to bring his Revision of 1848 up to date, Miquel published a short paper, in 1865, adding points and later records to existing descriptions. There Miquel stated that he was convinced that the *C. distyla* of Ventenat was identical with the *C. stricta* of Aiton. The description and figures given for the latter in his Review were of a sterile plant which he now decided was not *C. stricta*, but what species he was unable to determine. It is difficult to see why Miquel regarded *C. distyla* and *C. stricta* as synonyms, because the inadequate descriptions of Aiton's species more correctly describes *C. quadrivalvis*, Labill., than it does *C. distyla*, Vent. In this work Miquel also discussed the great variation in *C. distyla*, and as a result of his extended observations grouped many forms that he had previously regarded as separate species under the former. Among these were *C. rigida*, separated from *C. distyla*, in 1848, and *C. Fraseriana*. These forms were distinct in the herbarium, but he was not certain whether they might be merely growth forms consequent on habitat differences.

By this act of Miquel we can see the origin of the confusion existing in the "*Distyla* complex" to-day.

Mueller (1868) then published a description, under the name of *C. stricta*, Ait., of *C. distyla*, Vent., widened to embrace all the variation noted in herbarium specimens by Miquel, thus explaining why such species as *C. rigida*, *C. Muelleriana*, and *C. Baxteriana* have been lost.

Bentham, in the Flora Australiensis (1873), corrected the error, originated by Miquel and retained by Mueller, that *C. distyla* and *C. stricta* were identical. He pointed out that Labillardière's *C. quadrivalvis* was the same species as the *C. stricta* of Aiton. Bentham, however, adopted Mueller's wider definition of *C. distyla*, regarding *C. rigida* and *C. Muelleriana* as synonyms. It is to these all-embracing descriptions that one can trace the confusion existing throughout Australia to-day in the "*Distyla* complex," for each State claims to have *C. distyla*, and in most of them it is a different species.

In 1875-6 Tietkins and Young, the collectors of the Giles Expedition through Ooldea and Ouldabinna across the Western Australian border, added *C. lepidophloia* (then recorded as *C. glauca*) to the South Australian flora. *C. Decaisneana* also was collected from the Ashburton River during the journey; they were described shortly after by Mueller (1877).

The Elder Expedition (R. Helms, collector) added a further locality (Ferdinand River) for *C. lepidophloia* and also a doubtful record for *C. humilis* (Mueller and Tate, 1896).

Tate (1889) listed eight species of *Casuarina* for South Australia; of these *C. glauca* does not occur in this State, the records referring to *C. lepidophloia,* while *C. suberosa, C. bicuspidata,* and *C. humilis* have not been re-collected. *C. distyla,* in the sense used by Tate, refers to any of the four shrubby species separated below.

In 1899 R. T. Baker described both *C. Luehmanni,* which occurs near the Victorian border in the south-east of the State, and *C. Cambagei,* which is generally regarded as a synonym of *C. lepidophloia,* F. v. M.

More recently, ecological work in South Australia has directed attention to the great variation in the species regarded as *C. distyla.* Adamson and Osborn (1924) say of this species:—"The plant is exceedingly variable both in its size and general form. It occurs in all sizes from a small undershrub of 1 to 2 feet up to trees of 10 to 15 feet, and varies almost as much in its general shape. Most commonly it forms a spreading bush with no distinct main axis; at other times it is erect with rather fastigiate branching. The tree forms have ascending branches. How far some of these forms are distinct races or varieties is a matter that certainly calls for study and attention."

In 1925, Cleland and Black published a list of the flora of Encounter Bay, and there state that in the district *C. distyla* occurs in two forms, not separable morphologically, one a rounded shrub *(forma rotunda)* and one more spiky in appearance.

III. Present Work.

An anatomical investigation of a number of species of *Casuarina* shows that many of the species can be identified on the structure of the branchlets alone. It was somewhat surprising then, on sectioning the branchlets of the so-called *C. distyla* from various localities in the State, to find that the material provided, not mere variations in the one type, but two very distinct types of anatomical structure. It did not seem possible that habitat differences could greatly affect the internal structure of the branchlets, since a study of the variation of the branchlets of *C. stricta,* Ait., from many localities showed that, beyond minor differences, there was no serious departure from the structure normal for that species.

Field work in the Mount Lofty Ranges soon made it apparent that one was dealing with two species—one, a spreading, dioecious shrub with angular branchlets and red anthers; and the second, a more robust, fastigiate shrub with branchlets almost terete, golden-brown anthers, and shorter male spikes. Later, a dioecious shrub similar to the latter was found, but as a closer examination revealed no other differences between them than the dioecism, the two forms have been referred to the one species.

At this stage in the investigation the writer was able to examine the specimens in the National Herbaria of Sydney and Melbourne, where it was evident that a confusion existed among the specimens labelled *C. distyla.* Unfortunately the type specimen of this species is not housed in Australia.

On returning to South Australia, another small form was collected at Mount Compass, and then Professor Cleland kindly placed at my disposal all his *Casuarinas* from Encounter Bay. This collection contained a fourth form which abounds in that district. With two species collected in the Eastern States, the shrubby forms on hand numbered six, all of which were commonly known under the name of *C. distyla.*

In the determination of these species, and also *C. Baxteriana,* Miq., from Western Australia, full reliance has been placed on Miquel's descriptions, where, as in the case of *C. distyla,* type specimens were unavailable. Miquel's work is so comprehensive that it leaves very little possibility of error. The type speci-

mens of *C. rigida,* Miq. (both Fraser's and Hooker's specimens); *C. Baxteriana,* Miq.; *C. paludosa,* Sieb.; and *C. lepidophloia,* F. v. M., have been examined, and also the original descriptions of *C. distyla,* Vent.; *C. rigida,* Miq.; *C. Muelleriana,* Miq.; and *C. Baxteriana,* Miq.

IV. Specific Characteristics.

The present work has been rendered difficult by the extraordinary degree of variation within the majority of the species. Forms so closely related as those of the "*Distyla* complex" are not easy to identify at any time, but when they exhibit a wide range of variation in many characters which have, in the past, been regarded as being of taxonomic importance, they are increasingly difficult. It is not unlikely that hybridization is a cause of the variable nature of these plants and has obscured the original limits of the species. A noticeable feature of all the shrubby species of the "*Distyla* complex" is that a great percentage of the cones are partly sterile, and thus irregular in shape. This sterility favours the view that hybridization has occurred.

Perhaps the most striking variations, in any one species, are those in size and habit. It is not uncommon in South Australia to see *C. Muelleriana* growing to a height of 12 feet on the more favourable slopes of the hills, for instance at Belair, in the Mount Lofty Ranges, whilst on the top of those same hills it may reach only a height of 4 feet. In the Encounter Bay and Mount Compass districts, where edaphic conditions are more adverse, this species is frequently only 1 foot in height, seldom reaching above 4 feet. Nor is this the only shrubby species that shows this response to habitat differences. It is clearly noticeable in *C. rigida* around Sydney and on *C. striata* (n. sp.) in South Australia. The thickness and length of the assimilatory branchlets vary in different specimens, as does also the length of the internodes. In regard to the cones, which have always been regarded as being more or less constant within a species, there is extreme variation, in size and shape of the cones, the degree of acuteness of the bracteoles, the type of the apex (truncate, conical, or beaked, all of which may occur in different individuals of any one species growing in the same locality), the length of the peduncle, and the degree of sterility (pl. xiii.). Extensive field observations over the flowering season have shown that no reliance is to be placed on the dioecism or monoecism of any species. Some species, such as *C. Muelleriana,* are usually dioecious, but monoecious individuals have been collected, whilst in *C. striata* and in *C. paludosa,* var. *robusta* (n. var.) it is apparent that both conditions are equally common.

There are, however, several features which are constant throughout. One of the most important of these is the anatomical structure of the assimilatory *branchlets* and also that of the older *branches.* Ecological variations which are capable of producing marked responses in the more superficial characters do not appear to have any influence on the anatomical type of the plant, *i.e.,* whilst seasonal variation may increase or lessen the tannin content of a branchlet, or arid conditions increase the degree of lignification, the fundamental plan of construction remains unchanged. This being so, the anatomical study of the family as a whole will be a very valuable guide as to affinity, as well as giving, in certain species at least, a check on classification. Such points as the presence or absence of a large T-shaped band of fibres in the ridges, the type of development of the periderm, which influences the degree of striation in the branches, and also the particular type of medullary ray present, whether it be aggregate, compound, or diffuse, would be really valuable assets to taxonomic work.

The angularity of the branchlets seems to be a reliable point. Whether a branchlet is angular or terete rests, ultimately, on the shape of the ridges; sometimes they are gently rounded or flattened, giving the stem a terete appearance as

in *C. pusilla* (n. sp.) and *C. paludosa*, var. *robusta* (n. var.), sometimes as in *C. Muelleriana, C. Baxteriana, C. rigida*, and to a lesser extent in *C. distyla*, there is a prominent obtuse angle in the median plane of each ridge so that the stem appears angular. The shape and size of the leaf teeth and the number of teeth in a whorl are also good specific points. As regards the cone, it would seem that only the presence or absence of the drosal protuberance of the valves (bracteoles), and the degree of protrusion in them, are really worth consideration, all other points seeming variable.

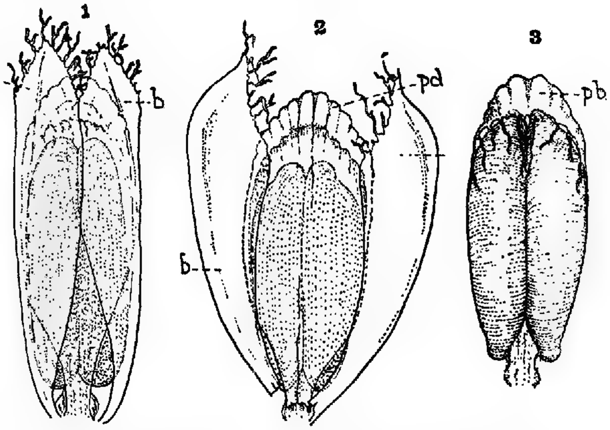
The greatest assistance in taxonomic work in the genus is to be gleaned from the male flowers. The mean length of the male spike is of importance, but in working on any one individual it is not unusual to find the male inflorescence varying from 1-6 cm. in length. However, with several specimens at hand, it is not difficult to determine the average length of the spike. The arrangement of the sheaths on the axis, whether they are overlapping, merely touching, or arranged so as to leave a small portion of the axis bare, is a constant feature. In three of the South Australian species the bracteoles are shed on the opening of the flower, whilst in the remaining species they are retained. In *C. stricta* the two bracteoles are woody and cohere along the upper abaxial margin by means of branching hairs. These points have been found to be very useful in the present consideration. The size relation between the persistent bracteoles and the sheathing teeth also appears to be constant, and can, therefore, rank among the more specific characteristics of the genus. The classification given is based upon the points enumerated above, and, whilst anatomical data do not figure in the key, a consideration of the anatomy underlies the grouping throughout.

V. The Male Flowers.

The buds of *Casuarina* are small, and consequently difficult to dissect; however, their small size is of advantage because the whole flower can be examined microscopically. The buds were rendered transparent with chloral hydrate, and after the removal of the bracteoles and the perianth segments, each part was treated with phloroglucinol to see the distribution of lignified tissue within them. Drawings have been made with the aid of the camera lucida, and, with the exception of those of the sheathing teeth, from uncovered preparations, so that all distortion through squashing would be eliminated.

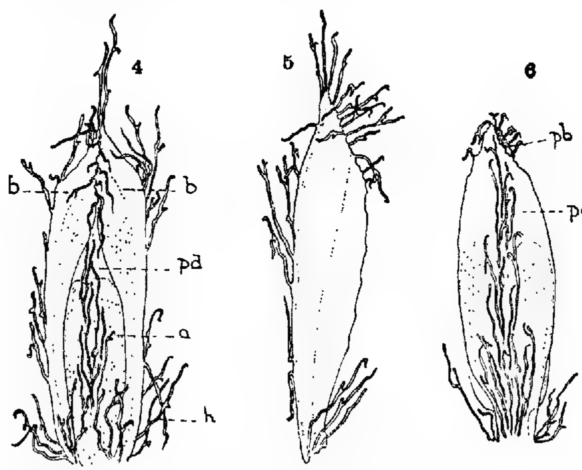
There is much uniformity in the male flowers of the genus. The spikes consist of a varying number of sheaths arranged closely on the axis. Each sheath is composed of floral bracts, free at the tips but joined laterally in the greater part of their length to form the sheath (fig. 33). These floral bracts exactly reproduce the type of leaf teeth found in the vegetative portion of the plant. A single flower occurs in the axil of each bract (fig. 11); this consists, in the bud, of one stamen, two perianth segments, and two bracteoles (figs. 1-3). The anther in the open flower is mounted on a long filament (fig. 11) and is basifixed; it shows two lobes slightly separating at the top and dehiscing longitudinally. The terminal portion of the lobe is frequently woody, while the basal part is more or less lobed (fig. 17). In the unopen bud the stamen is protected by the two perianth segments (fig. 2), which lie on the adaxial and the abaxial face of the anther. These perianth segments are usually hooded and ciliate (fig. 3), the smaller inner one which, however, is inserted below the larger outer segment, covers the abaxial side of the anther while in the bud and forms a hood over the top or wraps around the inner face; the outer segment covers the adaxial face and is hooded over both the stamen and the inner segment; the hood facing the floral bracts. The perianth segments do not cohere into a cap as the earlier workers thought, but each one individually folds over the anther. With the extension of the filament, on the opening of the flower, these perianth segments break off at the base and are

carried up by the stamen. There is no record of a species in which the perianth segments are persistent. It sometimes occurs that the abaxial segment is not developed *(e.g., C. stricta)*.



Figs. 1-3. Bud of *C. paludosa,* var. *robusta.*
Fig. 1—Abaxial view; b, bracteole. Fig. 2—Adaxial view with bracteoles pulled back; pd, adaxial perianth segment. Fig. 3—Bud with outer perianth segment removed; pb, abaxial perianth segment. x33.

The bracteoles belong to a different series, being decussate with the perianth segments and inserted together on the axis at a point lower than that of the insertion of the lowest perianth segment. At the base they show a thickened midrib laterally placed and two equal wing-like extensions. Further up they appear to turn slightly, so that the midrib finally lies exactly on the angle between the back



Figs. 4-6. Bud of *C. Luehmanni.*
Fig. 4—Adaxial view of bud; a, anther; h, hairs. Fig. 5—Adaxial view of bracteole. Fig. 6—Bud with bracteoles removed, leaving the perianth segments and the anther. x33.

and lateral portion of the anther. The bracteoles then become definitely and unevenly keeled (fig. 2), the smaller sides covering the abaxial face (fig. 1) of the anther and the perianth segments; the larger ones curving around the

side, but scarcely covering the axial portion. The bracteoles have invariably a well-marked mass of fibres along the midrib, and frequently the cells of the wings are lignified, but only in one case has any trace of tracheides been noticed. (The perianth segments are generally devoid of all lignified tissue.) In some species these bracteoles are retained (fig. 11), but in several they are shed with the perianth segments on the opening of the flower (fig. 15).

From the consideration of the foregoing facts it will be seen that two types of opened flower are possible—those which consist solely of a stamen subtended by its floral bract, as in *C. Luehmanni, C. stricta,* and *C. striata;* and those which retain the bracteoles. In the latter case these persistent bracteoles may be either enclosed in the sheath, as in *C. lepidophloia* (fig. 13) and *C. paludosa* (fig. 20), or exsert (figs. 19, 23, and 30). This, of course, depends mainly on the length of the sheathing teeth (bracts), which is constant within any one species; it follows that the degree of protrusion of the bracteoles has specific value.

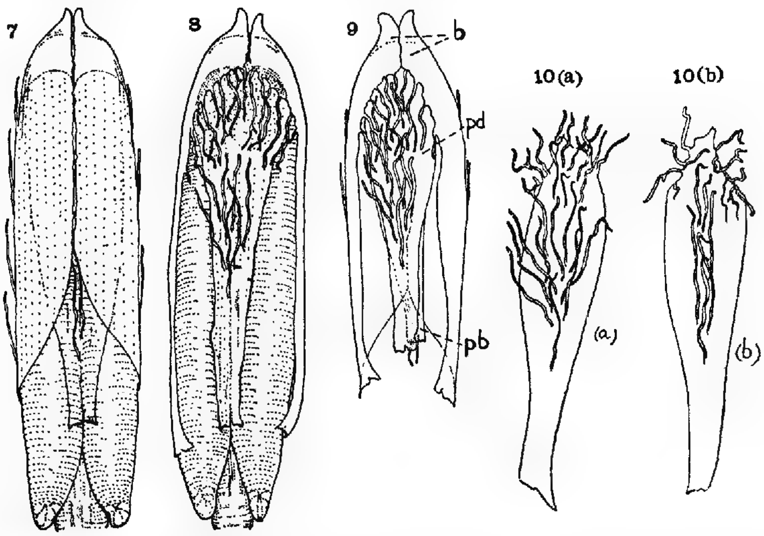
Roughly speaking, the buds of the species investigated are of two types. Of the first, *C. Luehmanni* is the simplest form, whilst *C. distyla* or *C. paludosa,* var. *robusta,* may exemplify the second. Some species, such as *C. lepidophloia* and *C. striata,* are transitional between the two.

Of the first group, there are only two examples among the South Australian species; these are *C. Luehmanni* (figs. 4-6) and *C. stricta* (figs. 7-10), the latter having a more complicated type of bud. Both are characterised by a degree of hairiness not found on the buds of other species investigated. In both, bracteoles are well developed, very woody, but deciduous in the mature flower. Long branching hairs are present on the upper margins of the bracteoles and along the midrib of the outer side (figs. 5 and 9). The perianth segments are also characterised by the possession of long hairs on the outer faces (figs. 6 and 10); these hairs are arranged along, and confined to, the middle portion of the segments, beginning below the centre and being directed upwards as they are on the midrib of the bracteoles. In neither case are the perianth segments wide, folded, or hooded about the anther, but simply providing a cover. *C. Luehmanni* differs from *C. stricta* in having two separate bracteoles and in the presence of long branching hairs arising from the base of the bud (fig. 4). In the former, the perianth segments are spoon-shaped and ciliate, with many short, much-branched hairs at the top. The perianth segments are much longer than the anther which they enclose, and are interlocked at the top by means of the hairs (fig. 6). In *C. stricta* the two bracteoles are coherent in the upper portion by means of their branched hairs (figs. 8 and 9), and are joined about two-thirds of the way down the back (fig. 7) by shorter branched cilia, while the axial portion is almost free (fig. 8). Inside these bracteoles are the perianth segments. It frequently happens that the abaxial perianth segment in *C. stricta* is missing, that is, it is not differentiated, as sectioning the buds clearly shows; but in many of the specimens examined the two were present. Certainly, if it is inconstantly present, then, when absent, it is aborted, and there is no possibility of the union of the two segments, as the slightly bilobed nature of the adaxial one [fig. 10(a)] might suggest (Black, 1919). This appearance is due to the perianth segment being moulded to the shape of the anther. The two bracteoles being coherent along the greater part of their abaxial face would suggest that the inner perianth is unnecessary. It is obvious that Labillardière (1806) noted the presence, in some cases at any rate, of the second perianth segment, since he named the species "*quadrivalvis.*" Bornet (1873) states that whilst it is usual to find in *C. stricta* a 3-valved perianth, "in very rare instances a fourth valve has been found pressed against the anterior face of the stamen." The two perianth segments are very much of the same size [figs. 10(a) and 10(b)], but the inner one is narrower and has fewer hairs more

strictly confined to the median portion. When the flower opens the four parts are carried up as a cap and are shed simultaneously (fig. 9).

Both the above species have the same type of leaf teeth, being long, lanceolate and ciliate, the same type of anther, rather flattened and not at all oblong, and agree in having deciduous bracteoles. Moreover, anatomical examination emphasises the close relationship between them.

C. lepidophloia (figs. 11-13), whilst exhibiting the same type of leaf teeth (fig. 13) and anther, has a much simpler bud. The persistent bracteoles (fig. 11) of this species are more ovate than keeled, especially in the young state; they are ciliate with long branched hairs along the margin (fig. 12), but only show a few scattered hairs along the midrib. They are unique among those species investigated in that they possess, in addition to the fibres which are present in the midrib of all the other species, a distinct row of tracheides running almost to the top of the



Figs. 7-10. Bud of *C. stricta.*

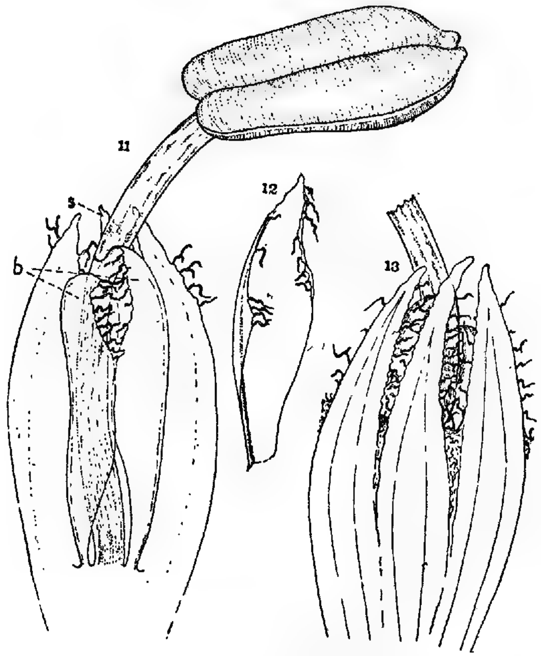
Fig. 7—Abaxial view of bud. Fig. 8—Adaxial view of same. Fig. 9—The floral parts, two coherent bracteoles and two perianth segments, pushed off from an opening bud. Fig 10—The two perianth segments: (a) the adaxial and (b) the abaxial segment. x33.

bracteoles. The perianth segments, which are also strongly lignified, possess neither tracheides nor fibres. They are also slightly hairy along the back. The anther is more rounded at the base (fig. 11) and has not the prominent lobed extension in the basal region noted in the two preceding species.

In the open flower of *C. striata* (figs. 14-16) the bracteoles are shed, as they are in *C. Luehmanni* and *C. stricta.* There is a departure here from the type of sheathing teeth found in the species previously described. The teeth are ovate-lanceolate and overlapping (fig. 15); the bracteoles are ciliate with long branched hairs on the margin, but glabrous on the midrib (fig. 16). The perianth segments are quite unlike those of *C. stricta* and *C. Luehmanni* in that they are wrapped around the anther, each segment completely covering one, and nearly covering the second face [figs. 14(a), (b), (c)]. The perianth segments are ciliate on the margins and show a few scattered hairs on the back [fig. 14(b)]. Long hairs, branching or simple, arise from the base of the bud (fig. 16), as in *C. Luehmanni.* The anther is similar in shape to that of *C. stricta.*

The remaining five species investigated *(C. rigida, C. distyla, C. paludosa,* var. *robusta, C. pusilla,* and *C. Muelleriana)* have buds and flowers which show a great similarity. The bracteoles are in every case persistent and glabrous along the midrib; the anther is different in shape from those of the species described above, being more ovate, and narrower towards the basal end, which is usually more strongly lobed. The perianth segments are hooded or folded, and are glabrous on the back. In no case is the bud extremely ciliate, nor has it long hairs arising from the base.

There are minor differences among the buds of the five species. *C. rigida* (figs. 17-19) has a very large bud and flower, the sheathing teeth (fig. 19) being essentially of the same type as those of *C. striata,* but of much greater length. Owing to this fact the bracteoles do not protrude to any great extent beyond the teeth (figs. 17 and 19). Both floral whorls and the sheathing teeth are almost glabrous at the margins (fig. 18). *C. distyla* (figs. 27-29) and *C. pusilla* (figs.



Figs. 11-13. *C. lepidophloia.*
Fig. 11—Adaxial view of male flower; s, sheathing tooth (floral bract). Fig. 12—Ovate-lanceolate bracteole from open flower. Fig. 13—Abaxial view of flower with anther and portion of filament removed. x25.

22-26) both show a very small bud and they are much alike. Since the sheathing teeth of *C. distyla* are somewhat longer than those of *C. pusilla,* the bracteoles of the former species scarcely protrude above the teeth (fig. 28), whilst in *C. pusilla* about one-third of the bracteoles is visible above the leaf teeth (fig. 23). The anther of *C. pusilla* (fig. 22) is much narrower and more pointed towards the basal end than is that of *C. distyla* (fig. 28). *C. paludosa,* var. *robusta* (figs. 20 and 21), has exactly the same type of flower as has the species itself. The flower and bud are much longer than those of *C. distyla* and *C. pusilla,* the sheathing teeth are different, being long, more lanceolate, and do not overlap (fig. 20). The bracteoles are scarcely visible above the long teeth (fig. 20), a fact which is useful in distinguishing this species from *C. pusilla.* The margin of the floral parts, and

also of the sheathing floral teeth, are more ciliate than in the two species previously described.

C. Muelleriana (figs. 30-33) differs in having dark-red or purplish anthers, more widely ovate than in other species; the bracteoles are more massive, and the sheathing teeth are unique among South Australian species in that they are triangular and short (fig. 33); in this respect they agree with the closely related species *C. Baxteriana* and *C. nana*. The perianth segments (figs. 31 and 32) are folded and wrapped around the anther, as in *C. striata*.

VI. Key to the Species of the "Distyla complex."

Branchlets simple, ascending; sheathing teeth, 5-9; cone valves scarcely prominent; valves with a conspicuous dorsal protuberance.

A. Bracteoles of male flowers deciduous; internodes 1-2 cm. long; male spikes 2-3 cm. long, cylindrical; anthers golden-brown. Tall spiky shrub .. .. *C. striata*, 1

A. Bracteoles of male flowers persistent.

- B. Internodes 1-1·8 cm. long; branchlets robust; male spikes long (up to 8 cm.), robust; moniliform; anthers yellow. Tall shrub with angular branchlets .. .. *C. rigida*, 2
- B. Internodes 1 cm. or under; branchlets less robust; male spikes under 6 cm.
  - C. Branchlets terete; small shrubs; cones under 2 cms. long.
    - D. Sheathing teeth 6-8, narrow-lanceolate, long; bracteoles of male flowers not exsert.
      - Slender shrub; male spikes about 2 cm. long, almost imbricate, branchlets heptagonal-terete; grooves frequently hairy; teeth not ciliolate .. .. *C. paludosa*, 3
      - More robust, spiky shrub; male spikes up to 6 cm. long, robust; branchlets cylindrical; grooves not hairy; teeth ciliolate .. .. *C. paludosa*, var. *robusta*, 3A
    - D. Sheathing teeth 5-7, ovate-lanceolate, short; bracteoles of male flowers exsert; male spikes 2-3 cm. long, slender; anthers rust coloured. Low cushion-like shrub .. .. .. *C. pusilla*, 4
  - C. Branchlets angular; cones over 2 cm. long; sheathing teeth short; male spikes moniliform. Taller shrubs.
    - Sheathing teeth 6-8, ovate-lanceolate; male spikes 2-3 cm. long; bracteoles scarcely exsert; anthers reddish-brown .. .. *L. distyla*, 5
    - Sheathing teeth 5-7, triangular; male spikes up to 5·5 cm. long; bracteoles exsert; sheaths remote; anthers red. Rounded shrub .. .. *C. Muelleriana*, 6

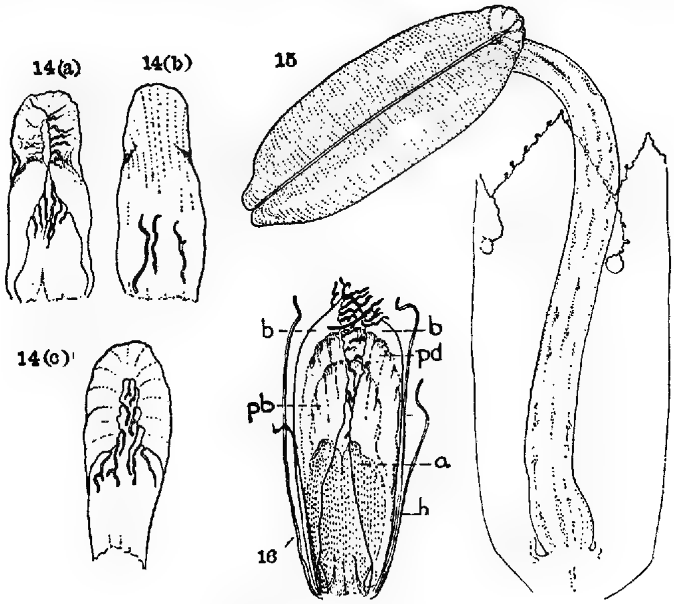
VII. Description of Species.

1. Casuarina striata, n. sp.

Frutex 1·5-5 m. altus, ramis striatis ob folia adnata; ramulis strictis, simplicibus, robustis, erectis vel unilateralibus, 14 cm. longis, vulgo brevioribus, fere teretibus, foliorum adnatorum angulis obtusis; internodiis 1-2 cm., saepius 1·5 cm. longis, 1·5 mm. crassis; vaginarum dentibus 6-8, vulgo 7, ovato-lanceolatis, acutis, junioribus ciliolatis, adultis fere glabris, appressis, demum truncatis, vaginis e flavo pallide viridibus, dentibus brunneis, ramorum dentibus longis recurvisque; amentis masculinis fere cylindricis, 1-3 cm. longis, vaginis paene imbricatis, bracteolis deciduis; antheris aureo-brunneis; strobilis breviter pedunculatis, cylindricis vel oblongis, plerumque 2·5 cm. longis; bracteolarum protuberantiis dorsalibus conspicuis, bracteolis ellipticis.

A very variable shrub, dioecious or monoecious, somewhat fastigiate and spiky, 2-15 feet high, frequently assuming the form of a small tree. Trunk smooth, light grey; branches whorled, bare in the lower portions, marked with circular scars, between which the parallel adherent leaves are clearly visible, making both young and old branches distinctly striate. Branchlets robust, erect and unilateral, up to 14 cm. long, but frequently shorter and more or less curved,

especially in pollen-bearing plants, almost terete, but with a slight raised portion in the median plane of the ridges, in dried specimens more angular; furrows scantily marked with hairs. Internodes 1-2 cm. long, usually about 1·5 cm., 1·5 mm. in diameter, or sometimes more slender in plants bearing male spikes. Sheathing teeth short, 6-8, usually 7, ovate-lanceolate, appressed, acuminate, overlapping laterally; sheaths clearly visible to the naked eye; yellow; teeth brownish towards the tips, at first appressed, later slightly recurved, finally dying off and becoming truncate; no thickening of the branchlets under the nodes. Young branches with long, lanceolate, recurved teeth. Male spikes almost cylindrical, slender, terminal on branchlets of 7-8 cm. long or sessile on the permanent branches, spikes 1-3 cm. in length; sheaths almost overlapping, short, greenish-yellow, later yellowish-brown, with prominent hairy lines on the lower half. Bracteoles deciduous (fig. 15), keeled, glabrous on the midrib (fig. 16), shorter than the sheathing teeth; perianth segments hooded, ciliate on margins [figs. 14(a) and 14(c)]; anthers golden-brown; filaments exsert. Cones shortly



Figs. 14-16. *C. striata.*

Fig. 14—(a) Adaxial view of inner perianth segment; (b) abaxial view of same; (c) abaxial view of outer perianth segment. Fig. 15—Adaxial view of male flower. Fig. 16—Adaxial view of bud. x33.

pedunculate, narrow-cylindrical or ovoid, 2·5 cm. or longer, conical, truncate or beaked atop, reddish-brown when young, grey when ripe and sometimes irregularly shaped. Valves obtuse or slightly acute, rusty tomentum in the upper internal portion; dorsal protuberance well marked, bluntly pyramidal, about as long as the valves; bracts very distinct, large and green when young, tomentose along the margin and in the basal region, base shaped like an inverted triangle, upper portion long and acuminate.

Records.—Common throughout Mount Lofty Ranges: from Belair southward to Happy Valley, Aldgate to Echunga, Sturt Creek (Blandowski, 1849), Kuitpo, Mount Compass, Square Waterhole, Myponga, Hindmarsh Valley, Encounter Bay, Ashbourne, Currency Creek; Dudley Peninsula (1883, Tate Herb.), K.I.

Flowering Season.—June to December.

Probably no species in the genus shows a greater variation in both size and habit than does *C. striata.* Frequently, especially in the cone-bearing plants, the shrub is robust, fastigiate, and spiky (the spiky appearance being due to the leaders growing out very strongly before any branchlets arise). A more divaricate and straggling habit is especially noticeable in the pollen-bearing plants; this form is more slender. The long branches of the coning plants are frequently weighed down by the cones so that the bushes are very straggling, making any community in which this species is dominant difficult to penetrate.

C. striata and *C. paludosa,* var. *robusta,* show how unsafe it is to place reliance on dioecism or monoecism in this genus. Both conditions are present, and it is difficult to state which is the more frequent. Other variable features are the colour of the anthers, which may range from yellow to golden-brown, and the cones, the variation of which is shown in pl. xiii. A great proportion of the cones are sterile; this may be due, in some cases, to the scarcity of plants bearing pollen in certain communities. However, observation has shown the prevalence of sterile cones even where pollen is abundant, and also in monoecious individuals; in these cases, probably, the explanation will lie in hybridization.

The name "striata" was suggested by the very obvious striae, caused by the persistence of the adnate leaves on the branches and even the young trunk.

2. Casuarina rigida, Miquel, Rev. Cas., p. 61, tab. vii. D.

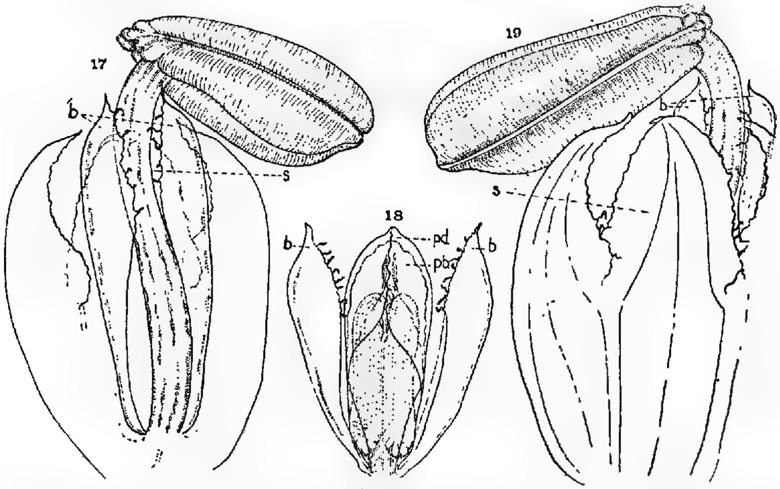
A dioecious or monoecious shrub varying in height from a small rounded bushy shrub of 2-3 feet in exposed situations to a small tree. Branches erect, striate with adnate leaves, teeth on younger branches long and recurved. Branchlets simple, rigid, robust, erect, angular, dark green, 5-30 cm. long, usually about a span. Internodes 1 to 1·8 cm. or longer, 1 to 1·5 mm. in diameter, distinctly angular owing to a prominently raised obtuse angle in the median plane of the ridge; furrows faintly marked by white hairy lines; internodes somewhat swollen under the sheaths. Sheathing teeth 6-9, usually 7, ovate-lanceolate or lanceolate, long, convex on the back, ciliate, triangular and appressed when young, later longer, narrower, erect and glabrous, finally truncate. Sheaths pale yellowish-green, easily visible to the naked eye; teeth golden-brown. Male spikes terminating branchlets or sessile on the permanent branches; spikes up to 8 cm. long; sheaths remote, leaving small portions of the axis bare, greenish, with base abruptly constricted. Bracteoles persistent (figs. 17 and 19), keeled, glabrous on back, ciliate on the upper edges (fig. 18), golden-brown, longer than the sheathing teeth (fig. 19); perianth segments hooded, ciliate (fig. 18); anthers yellow. Cones subsessile or on peduncles up to 1 cm. long, oblong, conical or truncate at apex or frequently beaked and partially sterile. Cones about 3 cm. long, but may be longer; valves elliptical or acute, scarcely prominent, rusty tomentum on the upper internal surface; bracts large and distinct; dorsal protuberance as long as the valves, pyramidal, obtuse or acute.—D.C. Prod., xvl., ii., p. 337.

Records.—Tasmania: George Town, Gunn No. 735*!*; and Queensland: Moreton Bay, Fraser*!* (both in Herb., Kew). New South Wales: around Sydney, Blue Mountains, Newport, Kincumber, J. H. Maiden*!*; Botany Bay, L. Boorman*!*, 1906; and Jervis Bay*!* (Sydney Herb.). Flinders Island (Bass Str., Adel. Herb.*!*)

Whilst examining the folders of material of *C. distyla* in the Sydney Herbarium, Mr. Cheel pointed out to me this species as one which occurred in the neighbourhood of Sydney, and he also kindly assisted me to collect material for investigation. The species is regarded there as being *C. distyla.* Through the courtesy of the Director of the Royal Herbarium at Kew, I have been privileged to examine the type specimens of *C. rigida* (both Gunn's and Fraser's

specimens), and find that they are identical with the Sydney specimens. It is difficult to understand why Bentham regarded these specimens as belonging to two different species, the more slender ones collected by Fraser as *C. suberosa* and those of Hooker as *C. distyla.* According to Herbarium records *C. rigida* is confined to the coastal regions of New South Wales. It extends into Queensland and southward into Flinders Island (Bass Strait) and to Tasmania. Of this species in Tasmania Hooker writes (1860): "It is a very common small bush, especially abundant near the sea, where it forms low thickets 2-5 feet high." The shrub is very variable in size, being a low bush in the exposed rocky outcrops of the Blue Mountains, but under more favourable conditions it is a small tree. Both dioecious and monoecious individuals have been seen; Fraser's specimen is monoecious, a fact that may have led Bentham to relate it more closely to *C. suberosa.* The extraordinary variation in the cone is well shown in pl. xiii.

C. rigida is closely related to *C. distyla,* but is sufficiently removed from it to receive specific rank. Some authorities regard it as lying nearer to *C. stricta,* but it shows the cone type generally exhibited by the "*Distyla* complex," the male flowers are more nearly allied to *C. distyla,* and, whilst the anatomy of the branchlets is similar, *C. rigida* shows greater lignification.



Figs. 17-19. *C. rigida.*
Fig. 17—Adaxial view of male flower. Fig. 18—Abaxial view of bud with bracteoles pulled back. Fig. 19—Abaxial view of flower. x25.

3. C. PALUDOSA, Sieb., in Spreng. Syst., iii., 803.

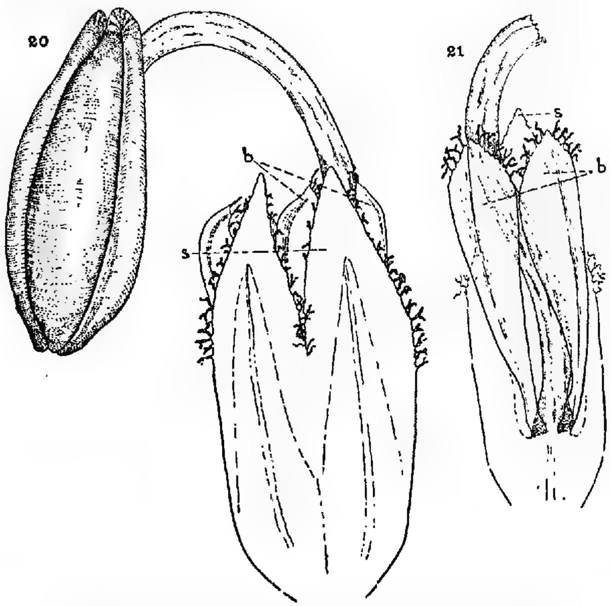
A low monoecious, erect shrub, branches striate with adnate leaves. Assimilatory branchlets whorled, short, strict, simple, terete, neither swollen nor constricted at nodes; internodes 5-6 mm. long, $\frac{2}{3}$ mm. in diameter, terete, or somewhat polygonal, owing to ridges being flattened, or sunken in the centre with a slightly raised portion on the margins; grooves frequently hairy. Sheathing teeth 7, rarely 6, subappressed, narrow-triangular or lanceolate, glabrous, rigid, thick, pale or yellowish. Male spikes usually whorled and sessile on the permanent branches, 1-2 cm. long, teeth narrow-lanceolate, long, glabrous when mature, bracteoles persistent, equal in length to the sheathing teeth; perianth segments hooded. Cones shortly pedunculate, oblong, small.—Miq., Rev. Cas., 64, t. 8 B, and in D.C., Prod., xvi., ii., 338; *C. pumila,* Otto, and Dietr., Allg. Gartenz., 1841, p. 163; Miq., Rev. Cas., 66, t. 8 C; *C. dumosa,* A. Cunn., Herb.; *C. distyla,* var. *paludosa,* Benth., Fl. Aus., vol. vi., p. 199.

An Eastern species; Port Jackson to the Blue Mountains, Sieber, n., 329!; Argyle county, A. Cunningham, Twofold Bay!.

3A. **Casuarina paludosa,** Sieb., var. **robusta,** n. var.

Variat ramulis robustioribus, internodiis longioribus amentis masculinis multo longioribus (usque ad 6·5 cm.), robustioribusque, vaginis non imbricatis.

A small dioecious or monoecious spiky shrub 1 to 4 feet in height, bright green when fresh, drying yellowish-green, erect, rigid, and with reddish-brown or grey branches, striate with adnate leaves. Assimilatory branchlets up to 13 cm. long, simple, rigid, robust, whorled, but frequently unilateral in position owing to a tendency to grow erect. Internodes 1 cm. long or under, 1 mm. in diameter; ridges rounded or with a slight raised portion in the median plane so that they are terete or almost so; furrows distinctly marked with hairs in young branchlets, but glabrous or faintly marked in older ones. Sheathing teeth 6-8, but usually



Figs. 20 and 21. *C. paludosa*, var. *robusta*.
Fig. 20—Abaxial view of male flower showing bract and bracteoles of a second flower. Fig. 21—Adaxial view of same with anther and portion of filament removed. x25.

7, long, narrow-lanceolate, acuminate, frequently recurved, ciliate, when old truncate and papery at the margin; sheaths yellow, teeth brown; nodes clearly marked. On the longer branches the teeth are very long, narrow-lanceolate, dry and recurved. There is no swelling at the nodes, the branchlets being of the same thickness everywhere. Male spikes deciduous, robust, terminal on assimilatory branchlets of 2 to 10 cm. in length, or borne sessile in whorls along the permanent branches, 2 to 6·5 cm. in length; sheaths not overlapping, sometimes exposing short portions of the bare axis, distinctly marked with white hairy lines in the lower part, straw colour, teeth golden, ciliate, narrow-lanceolate, acuminate and long. Bracteoles persistent (figs. 20 and 21), keeled, glabrous on back, ciliate on edges (figs. 1 and 2), not exceeding the sheathing teeth (fig. 20) except perhaps in the two basal sheaths, golden-brown; perianth segments hooded, glabrous on back, ciliate on margins (fig. 3); filaments exsert; anthers reddish-brown or rusty.

Cones borne in whorls on the older branches, sessile, cylindrical or globular, small, 1·5 to 2·5 cm. in length, usually truncate atop but sometimes conical or slightly beaked. In some specimens the valves are elliptical and scarcely protruding, with the dorsal protuberance as long as the valve, so that the cone is more regular. In others the valves are more prominent and longer than the dorsal protuberance. Bracts distinct in young cone, acuminate and long with a broad base, the long points being broken off later; valves with a rusty tomentum on the upper internal portion. Dorsal protuberance entire or divided into 1 to 3 lobes, sometimes acute. Cones sometimes irregular owing to partial sterility, reddish and hairy when young, ash-grey when ripe.

Records.—Mount Compass, Square Waterhole, Upper Hindmarsh Valley, Inman Hills (J. B. Cleland and E. D. M.), Myponga, Keith (J. M. Black), Wirrega (T. G. B. Osborn), Furner (T. B. Paltridge).

Usually occurring on stiff clay soils with little or no depth of sand.

Flowering Season.—January to August, much earlier than the other shrubby species.

There have been many difficulties in regard to this variety arising out of its close relationship with the Eastern species, *C. paludosa*, Sieb., which I have not been able to examine in the field. Although the plant is, in appearance, very different from the latter species, a detailed examination reveals the fact that this dissimilarity is apparent rather than real, since the differences are those of degree. The points in which the two differ are as follows: *C. paludosa* has male spikes usually borne sessile on the permanent branches, slender, short (up to 2 cm. long), and somewhat imbricate. The South Australian plant has spikes which are generally terminal on the assimilatory branchlets, robust, long (up to 6·5 cm.), and with sheaths not overlapping. Again *C. paludosa* is a slender plant with branchlets almost heptagonal-terete; the ridges are slightly sunken in the middle, with a raised portion on either side near the groove, giving the stem a slightly angular appearance. *C. paludosa*, var. *robusta*, has ridges rounded or with a slightly raised portion in the median plane. The grooves on *C. paludosa* are hairy with retrorse whitish hairs, whereas in *C. paludosa*, var. *robusta*, the grooves are seldom, if ever, hairy in the adult. In *C. paludosa* the teeth of the older branchlets are glabrous, but in the variety they are always ciliate. The close relationship of the two is clearly shown in the type of cone, the terete branches, the lanceolate leaf teeth (fig. 20), and the male flowers, which, in both species, show persistent bracteoles, shorter than the sheathing teeth.

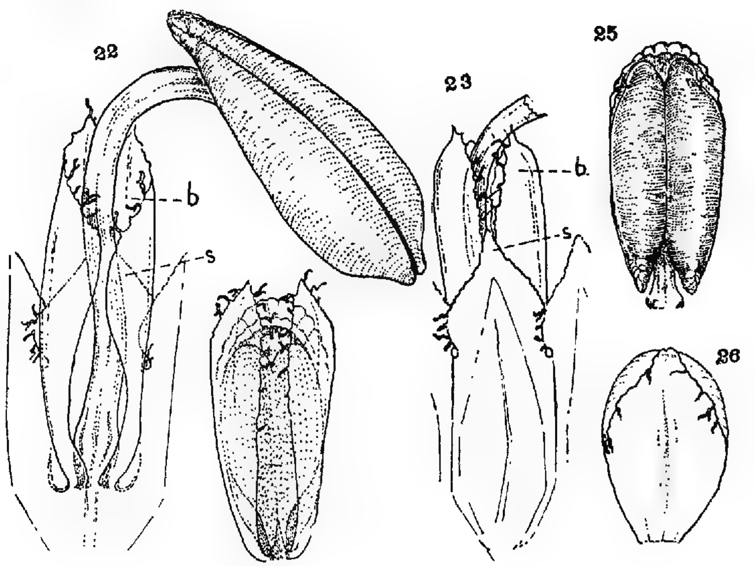
The splitting of the dorsal protuberance which has been noticed in this species has no systematic value since it is inconstant, a feature also noticed by Bentham in *C. Fraseriana*, Miq.

4. **C. pusilla**, n. sp.

Frutex humilis, ·25-1 m. altus, ramis erectis, junioribus vix striatis ob folia adnata, ramulis tenuibus, brevibus teretibus, strictis, erectis vel unilateralibus; internodiis 4-8 mm. longis, ·5 mm. crassis; vaginarum dentibus 5-7, brevibus, ovato-lanceolatis, ciliolatis appressis; amentis masculinis usque ad 2·5 cm., vulgo 2 cm. longis; vaginis subimbricatis; bracteolis persistentibus, exsertis; antheris ferrugineis strobilis sessilibus, globosis, parvis verticillatis, bracteolis ellipticis vel magis acutis, bracteolarum dorsalibus conspicuis.

A low, rounded, cushion-like dioecious shrub, 9 inches to 3 feet in height, with erect branches which are less striate than in the previous species, the striations being entirely lost in the older branches. Branchlets dark green when fresh, very slender, strict, erect or unilateral, wiry and sometimes curved, usually up to 8-9 cm. in length, smooth, glaucescent when dry. Internodes short, 4-8 mm. long, ·5 mm. in diameter, absolutely terete, with furrows faintly marked and not at all

hairy. The branchlets are cylindrical, being neither swollen nor contracted at the nodes. Sheathing teeth 5-7, short, ovate-lanceolate or nearly triangular, overlapping one another laterally, yellowish towards the sheath, but brown at tips, ciliate, appressed, never recurved except on the green branches which are sending out assimilatory shoots, where the teeth are longer and narrower. Nodes easily visible to the naked eye on account of the light-coloured sheaths. Male spikes terminal on whorled assimilatory branchlets up to 7 cm., spikes short, up to 2·5 cm. long, but usually about 2 cm.; sheaths more or less imbricate, funnel-shaped, shallow, yellowish; teeth brown, short, ovate-lanceolate, overlapping, ciliate only towards the grooves (fig. 23); bracteoles persistent, slightly keeled, much longer than the sheathing teeth (fig. 22); perianth segments hooded, slightly ciliate (fig. 26); anthers rust-coloured; filaments exsert; cones sessile, usually globular, small (pl. xiii.), up to 2 cm. in length, whorled on branches; valves elliptical or more acute, tomentose in the upper internal portion; dorsal protuberance well marked, not as long as the bracteoles, broad, bracts well developed; young cones reddish and tomentose, grey when mature, truncate or beaked atop, frequently irregular.



Figs. 22-26. *C. pusilla.*

Fig. 22—Adaxial view of male flower. Fig. 23—Abaxial view of same with anther and portion of filament removed. Fig. 24—Abaxial view of bud. Fig. 25—Adaxial view of same with bracteoles and outer perianth segment removed. Fig. 26—Adaxial perianth segment. x33.

Records.—Macclesfield to Strathalbyn (J. M. Black), Encounter Bay, Port Elliot (J. B. Cleland), Nuriootpa (Tepper), Wirrega (T. G. B. Osborn), Keith, South of Lameroo and Paringa (J. M. Black).

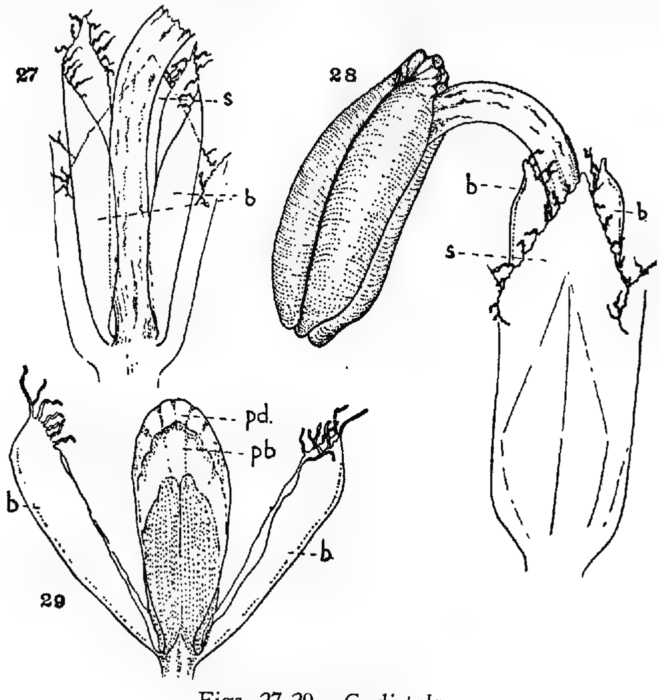
Flowering Season.—Not definitely known, but flowers have been collected in January and from May to August.

C. pusilla may be a strict, erect shrub with crowded branchlets, as is usually the case in coning plants, or it may be more divaricate in form. It has been recorded from the North-west Desert of Victoria (under the name of *C. paludosa,* in Natl. Herb., Victoria) and from South Australia; in the Tepper Herbarium it occurs under the name of *C. humilis.* Although the latter species has been

recorded from the Everard Range and the Eucla Basin, the records are doubtful. As regards the Everard Range locality, the loss of some of the specimens during the expedition gives complications (Mueller and Tate, 1896). In the Tate Herbarium one specimen bearing the characteristic cones of *C. humilis* has within the folder two labels, one bearing "Camp 9 (Everard Range), 23/6/91"; and the second, "Gnarlbine, W.A., 12/11/91." Another specimen collected at Camp 7 (Everard Range) has male flowers only, and shows a resemblance to *C. pusilla.* In reference to the Eucla Basin record of Tepper, one must bear in mind that he did not distinguish between *C. pusilla* and *C. humilis;* his specimen is not available.

5. CASUARINA DISTYLA, Ventenat, Plantes nouvelles, p. 62 (1803).

A diffuse, monoecious or dioecious shrub varying in size and habit in accordance with habitat differences. Branches erect, grey, striate with adnate leaves, those of the bushes bearing male flowers frequently long and straggling; assimilatory branchlets dark green, erect or unilateral, slender, short, 5-12 cm. long,



Figs. 27-29. *C. distyla.*
Fig. 27—Adaxial view of male flower with anther and portion of filament removed. Fig. 28—Abaxial view of same. Fig. 29—Adaxial view of bud with bracteoles pulled down. x33.

whorled or semi-whorled; internodes short, 5-8 or perhaps 1 cm. long, scarcely 1 mm. in diameter, angular in consequence of a distinct raised obtuse angle in the median plane of each ridge; furrows seldom marked with hairy lines. Sheathing teeth very short, 6-8, usually 7; sheaths yellow at base, thus nodes easily visible to the naked eye; teeth golden-brown, ovate-lanceolate, acute, overlapping, recurved, ciliate when young but later lacerate, finally truncate. Teeth of branches long, linear, brown, and recurved. Male spikes terminal on short assimilatory branchlets or lateral on the branches, 2-3 cm. in length, moniliform, sheaths leaving small portions of the axis bare. Bracteoles persistent (figs. 27 and 28), keeled.

glabrous on back, ciliate on upper margins (fig. 29), about the same length as the teeth in the open flower (fig. 28), or slightly longer, brownish in colour; perianth segments not united, hooded, ciliate, glabrous on back (fig. 29). Anthers red-brown, filaments exsert. Cones usually whorled, subsessile, narrow-cylindrical or globular, up to 3·5 cm. in length, conical atop, beaked or flattened with a short pointed apex. Valves (bracteoles) fairly prominent, elliptical or acute, with a rusty tomentum in the upper internal surface, dorsal protuberance bluntly pyramidal, well developed, nearly as long as the valves. Cones frequently irregular owing to partial sterility.—Miq., Rev. Cas., p. 57, tab. vii., A-C; *C. stricta*, Ait., in D.C. Prod., xvi., p. 336.

Records.—According to Miquel: "Tasmania. Ventenat and Hooker [Gunn, 735]; Gippsland, Mueller"; Victoria: Cheltenham.

Flowering Season.—Opening in June.

The material from which the above description and figures were taken was collected at Cheltenham, Victoria, and made available to me through the kindness of Messrs. Audas and Morris, of the National Herbarium of Melbourne.

Miquel, in his Review, separated Gunn's No. 735 into two species, *C. rigida* and *C. distyla.* In 1865, working on Herbarium material, he observed forms which seemed to him to be transitional between the two species. Consequently he merged *C. rigida* with *C. distyla.* Miquel's earlier work is to be commended in that some of these variations have proved to be constant, and provide the foundation for the present splitting of the "*Distyla* complex" into several species. In consequence of this it is necessary to redescribe *C. distyla* with the narrower limits set by Miquel in 1848.

Probably this species is limited in distribution to Tasmania and Victoria; the species regarded in New South Wales and Queensland as being *C. distyla* is *C. rigida*, in Western Australia *C. Baxteriana*, in South Australia *C. Muelleriana*, and the three other species not previously separated from that species. Apparently in Victoria *C. distyla* is confused with *C. Muelleriana* and *C. pusilla*, both of which also occur in that State.

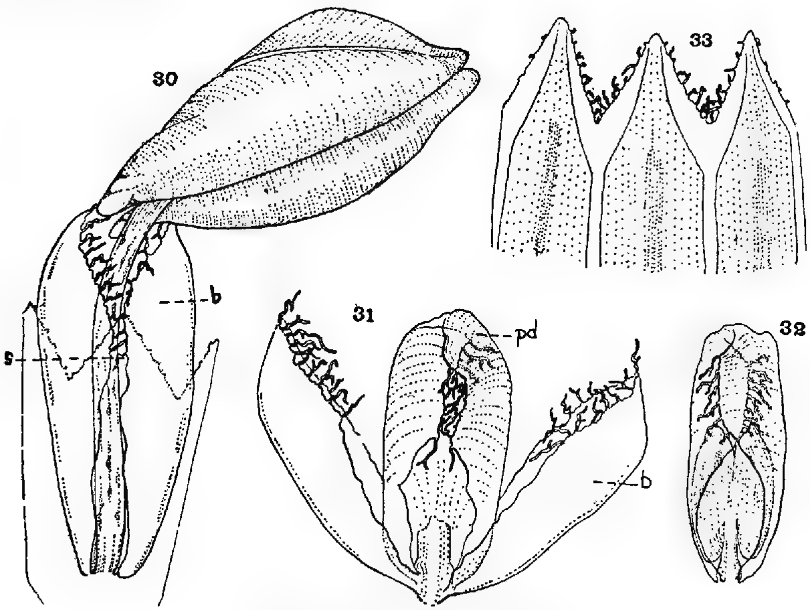
6. CASUARINA MUELLERIANA, Miq. in Ned. Kruidk. Arch., iv., 99.

A rounded shrub usually dioecious, varying in height from 1-12 feet, and forming a small tree in favourable situations. Trunk usually grey, with rough bark showing numerous clefts and without distinct striations, but occasionally of a lighter colour, smooth and striate to a slight degree, with adherent leaves. Branchlets erect, slender, rigid, simple, dark green, frequently with a red or yellow tinge, so that the whole bush appears reddish at a distance. Branchlets distinctly angular and whorled, up to 12 cm. long; internodes 5-8 mm. long, 1-1·5 mm. in diameter; furrows clearly marked with white hairy lines, ridges also slightly hairy. Sheathing teeth 5-7, usually 6, short, deltoid or narrower, convex on back and always appressed, edges rough, scarcely ciliate, greenish-yellow at base, bright red towards the tips and with hyaline margins. Male spikes terminal on branchlets 1-8 cm. long; spikes from 1·5-5·5 cm. long, reddish or yellow, slender. Sheaths remote, showing bare portions of the axis between each sheath, reddish-green or yellow at base, marked in the lower part with hairy lines; teeth red. Bracteoles persistent (fig. 30), keeled, glabrous on the back (fig. 31), much longer than the sheathing teeth (fig. 30), ciliate on margins, golden-brown; perianth segments hooded, folded about the anther, ciliate (fig. 32); anthers red; filaments short. Cones borne singly on the bare branches and surmounted by whorls of assimilatory branchlets, sessile or on peduncle of 5-8 mm. in length, ovoid or cylindrical, usually about 2·5 cm., but may be longer, about 1·5 cm. in diameter or even wider, truncate at top or beaked owing to the sterility of the upper whorls of flowers; beaks usually short, but specimens from National

Park, Belair, show a beak of 2 cm. in length (pl. xiii.). Valves slightly prominent, obtuse or elliptical, rusty tomentum on the upper internal surface, dorsal protuberance well marked, almost as long as valves, and bluntly pyramidal; bracts not large.—*C. suberosa,* O. et D., var. *Muelleriana,* Miq., in D. C. Prod., xvi., ii., p. 338.

Records.—South Australia: Mount Lofty Ranges (Mueller, 1850, in Vict. Herb.*!*), Black Hill, Morialta, Scott's Creek, Mount Torrens, Mount Crawford (T. G. B. Osborn), between Hallett's Cove and Noarlunga, Kuitpo, Mount Compass to Encounter Bay, Ashbourne; Coonalpyn (J. B. Cleland), Tintinara (under the name of *C. humilis);* Ardrossan (Tepper); West Coast, Port Lincoln (J. B. Cleland), Streaky Bay (Tepper), 40 miles north of Port Bell (Tepper, Tate Herbarium); Wilpena Pound; Kangaroo Island. Victoria: Mount Abrupt (H. B. Williamson, Vict. Herb.*!*).

Flowering Season.—May to October.



Figs. 30-33. *C. Muelleriana.*
Fig. 30—Adaxial view of male flower. Fig. 31—Abaxial view of bud with bracteoles pulled down and anther removed. Fig. 32—Adaxial view of anther and inner perianth segment showing the folding of the latter. Fig. 33—Three floral bracts. x33.

In many respects *C. Muelleriana* seems to be more stable than the other shrubby species. However, the cone is variable. Although this species is recognisable by certain constant features of the cone, namely, its greenish-brown colour, the large elliptical valves and the large blunt dorsal protuberance, there are many differences among individuals in size, degree of irregularity, and in the formation of a beak, which may even reach a length of 2 cm.

The type specimen was collected by Mueller at Mount Torrens in 1850 and described by Miquel (1859). Later, in the Prodomus, he refers to it as being, with *C. Baxteriana,* a variety of *C. suberosa,* O. et D. Mueller has never distinguished it from *C. distyla,* although he must have handled both species; Bentham, too, regarded it as synonymous with *C. distyla. C. Muelleriana* shows very obvious affinities with *C. suberosa,* but certainly merits specific rank. It has the same

type of angular branchlet, cone, and male flower as has *C. suberosa,* but what is of more significance is that the anatomy of *C. suberosa* (fig. 40), *C. Muelleriana* (fig. 39), and *C. Baxteriana* are of the same type, and differ greatly from the type of anatomy shown by *C. distyla* (fig. 38) as well as all the other species in South Australia (see Section VIII. of this paper).

C. Muelleriana occurs in Victoria and in South Australia, but probably is replaced by the closely related species, *C. Baxteriana,* in Western Australia. I have examined the type specimen (female only) of *C. Baxteriana* (in Herb., Kew). Pritzel's No. 238, called *C. distyla* (male only, King George's Sound), is the same species. *C. Baxteriana* differs slightly from *C. Muelleriana.* It has seven sheathing teeth of the same type as *C. Muelleriana,* which has usually only 5 or 6 teeth. The anatomical structure is intermediate between *C. suberosa* and *C. Muelleriana.* It is apparent that the species described by Diels and Pritzel as *C. distyla,* Vent., is Miquel's *C. Baxteriana.* With only two incomplete specimens available it is useless to attempt a description of the latter species, nor can one state in what respects, beyond those mentioned, it differs from *C. Muelleriana.* It may, perhaps, be a variety of that species.

VIII. The Anatomy of the Assimilatory Branchlets.

1. *General.*

The history of the anatomical work done on this genus has been summarised by Boodle and Worsdell (1894) and by de Cordemoy (1923), thus it is unnecessary to make further comment on it here.

It is well known that all the species of *Casuarina* are characterised by the switch habit. The vegetative structure consists of a number of primary assimilatory branchlets, inserted in whorls on the small branches, which are, in turn, verticillate, or potentially so, upon the larger branches. The assimilatory branchlets are divided into nodes and internodes, the latter being green, and showing ridges and furrows running longitudinally. At the nodes whorls of leaves are inserted; these are unique in that, for the length of the entire internode above their insertion, they are concrescent with the stem and constitute the ridges. At the node above the leaves become free from the stem, and, uniting by their lateral margins, form a sheath which covers the base of the next internode. This sheath ends in a number of teeth, which represent the only portion of the leaves entirely free. It was the foregoing features in the leaves that led Loew to designate them "phyllichnia." Their number and shape vary greatly in the different species. The verticillate phyllichnia of any one internode alternate with those of the internode above, and, consequently, the furrows, which represent the spaces between them, will also be arranged alternately. These furrows contain numerous branched hairs which arise from the base; frequently they project through the opening of the furrow, making white lines running lengthwise along the internode. In some species the ridges persist upon the branches giving them a somewhat striate appearance.

On the morphological peculiarities, the seedling throws no light since there is no essential difference between the juvenile and adult foliage. The seedling shows two normal fleshy cotyledons, slightly connate at the base, showing a reticulate type of venation, a point which it is interesting to note, since such veining is generally considered absent from the adult phyllichnia. The first shoot is exactly of the same type of construction as the mature branchlet.

The anatomical structure of the assimilatory branchlets shows general uniformity, but there are many minor differences, some of which are constant and are of value in the recognition of species. The simplest structure in the species examined was shown by *C. stricta,* Ait., thus its anatomy will be fully described as a basis for comparison with the other species.

2. *C. stricta,* Ait.

A transverse section of the assimilatory branchlet of *C. stricta* (figs. 34 and 35) shows 9 to 12 pentagonal ridges, separated by deep furrows. The external face of the ridge shows a more or less distinct obtuse angle in its median plane. The corners marking the entry to the groove are rounded and not showing the projecting masses of cuticle so evident in *C. lepidophloia, C. Cunninghamiana,* and *C. Fraseriana.* A thick cuticle with small refractive globules, probably of silica,[2] is present on the epidermis of the ridges and extends into the furrow. The epidermal cells of the ridges have very thick walls, and in surface view they are shown to be pitted. Scattered branching hairs, which are directed upwards, occur on the external face of the ridges; the bases of these appear in transverse section as cuticular rings. Branched hairs also spring from two or three rows of narrow and elongated epidermal cells running lengthwise along the base of the furrow. Frequently the hairs project through the opening of the furrow, giving white hairy lines between the ridges. The basal portion of the hairs is suberised, but the upper part is sclerised. Undoubtedly these protect the stomata, which are arranged in three or four rows on either side of the basal hairs, but occupying only the lower part of the groove. In the seedling the stomata are not confined to so sheltered a position, but occur on both sides of the cotyledon and on the adaxial side of the young free leaf teeth, where they are arranged in longitudinal rows. The stomates of the genus are peculiar in that they show the same type of transverse pore that is present in Gymnosperms.

Under the epidermis of the ridges a T-shaped mass of fibres occurs, portion of which forms a median band of cells running thickly from the epidermis, but tapering as it approaches the inner limits of the ridge. The arms of the T are formed by two or three rows of fibres extending underneath the epidermis of the ridge and to the stomatal region of the furrow. Scattered among these fibres are large clear cells with thin but lignified and pitted walls; these are elongated longitudinally and are frequently fibre-like in shape, being probably derived from fibres. Possibly they act in the capacity of water-storage cells. These cells frequently contain tannin. The ridges are mainly concerned with photosynthesis, since they alone contain the chlorenchyma. In *C. stricta* this is divided into two symmetrical masses by the T-shaped band of fibres, and lies on either side of them, arranged in two or three definite rows. Longitudinal sections show that the row nearest the fibres is densely packed, while the others are loosely packed and show many air spaces. In the neighbourhood of the stomata intercellular spaces occur.

At the base of the ridges, lying immediately under the central band of the fibres, and separated from the tissue of the ridge by a single row of cells, are the leaf-trace bundles. These are inserted at the node below, run up through the internode, and pass out through the sheath into the free portion of the phyllichnium. In association with these bundles, on either side lie the transfusion tracheides, which stretch, under the chlorenchyma, almost to the groove.

All the tissue hitherto described belongs to the leaf system of the branchlet; the remaining portion constitutes the stem system. The cortex stretches from the epidermis of the groove to the central cylinder, dipping under each leaf trace. The stem bundles alternate with the foliar bundles; they lie beneath the furrows. They are collateral and are separated from one another by medullary rays of varying width. A small group of pericyclic fibres occurs outside the phloem region, and a second group of fibres may be found on the internal side of the bundles, bordering the pith. Both pith and cortex are wide and unlignified.

---

(2) Refractory, but soluble in hydrofluoric acid.

Having described the general plan one can deal briefly with the leaf trace and the transfusion tissue. The foliar bundle is separated from the ridges by a single row of large round cells; it shows the usual orientation of leaf bundles. The phloem is extensively developed and is extended tangentially, making a crescent-shaped mass. In the depression at the top of the crescent lies a small group of fibres, probably developed, as M. de Cordemoy suggests, from the peridesm of the bundle. On the inner side of the phloem there is a small triangular group of vessels; also, at intervals, along the lateral margins of the

34

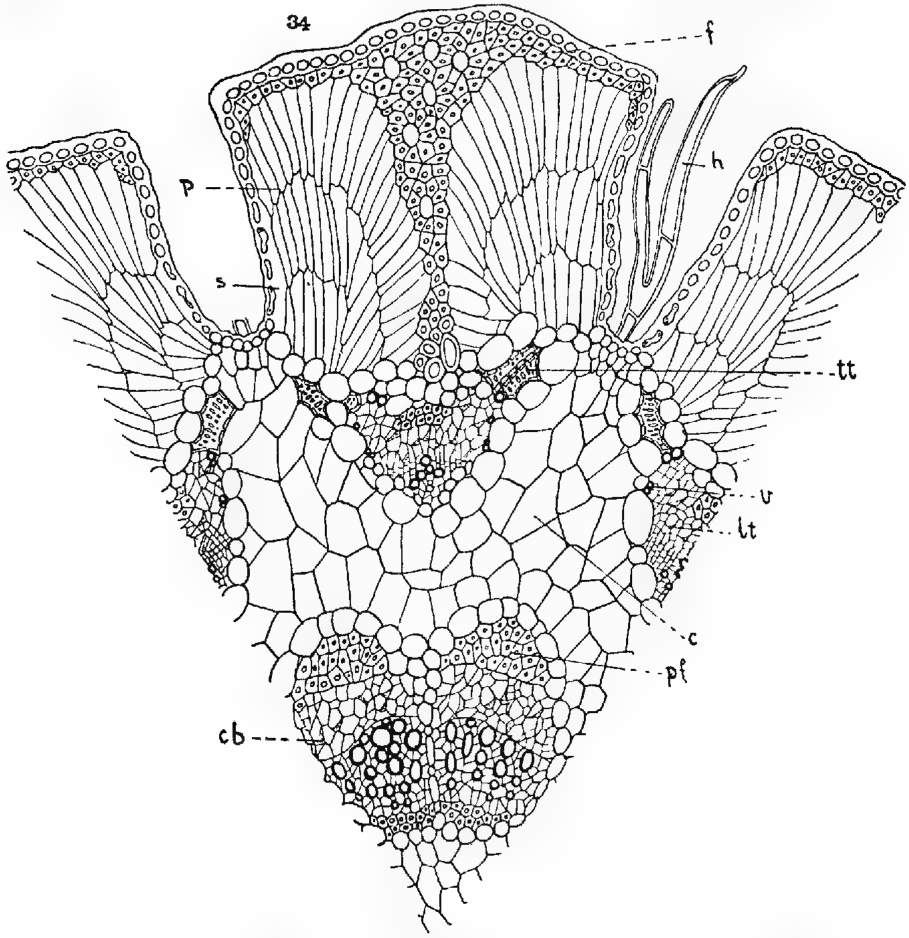


Fig. 34.

Fig. 34—Transverse section of the assimilatory branchlet of *C. stricta;* f, hypodermal fibres; p, palisade; lt, leaf-trace bundle; tt, transfusion tissue; v, lateral tracheides of the leaf-trace bundle; c, cortex; cb, cauline bundle; pf, pericyclic fibres; s, stomatal region; h, branched hair. x173. Camera lucida outlines.

phloem, isolated tracheides or small groups occur. Thus the whole bundle is triangular and loosely surrounded by lignified elements, vessels, tracheides or fibres. The transfusion tracheides, which are large cells with thick lignified walls, showing simple pits, are either directly or indirectly in contact with the lateral elements forming the arms of the V. The peculiarities of the V-shaped leaf-trace bundles and the transfusion tracheides will be dealt with more fully later; they will not be further discussed at present.

3. *The Comparative Anatomy of the "Distyla complex" and of the other South Australian species.*

The anatomical differences which have been noted in the species investigated are, for the most part, due to variation in the degree of lignification. Some such differences are inconstant, such as the occasional presence of a lignified pith and cortex in a species usually unlignified in these portions. These small variations may be connected with different ecological conditions. However, there are some features which have proved to be constant and may be used in taxonomic work, thus many of the species are readily identified by their anatomical structure. However, it is impossible to distinguish between some of the closely allied species where specific differences do not extend to the more stable anatomical characters.

The structure of the branchlets of those species investigated falls into two distinct types; these may be termed the "Stricta type" (fig. 34) and the "Muelleriana type" (fig. 41). This division rests on the presence or absence of the median band which gives the T-shaped disposition to the hypodermal mass of fibres in the ridges. In the "Stricta type" the median band is invariably present, and usually runs down as far as the level of the groove. However, in the "Muelleriana type" it is absent or only slightly developed, and does not, in any case, extend to the level of the groove. Between the two extremes there are transitional forms.

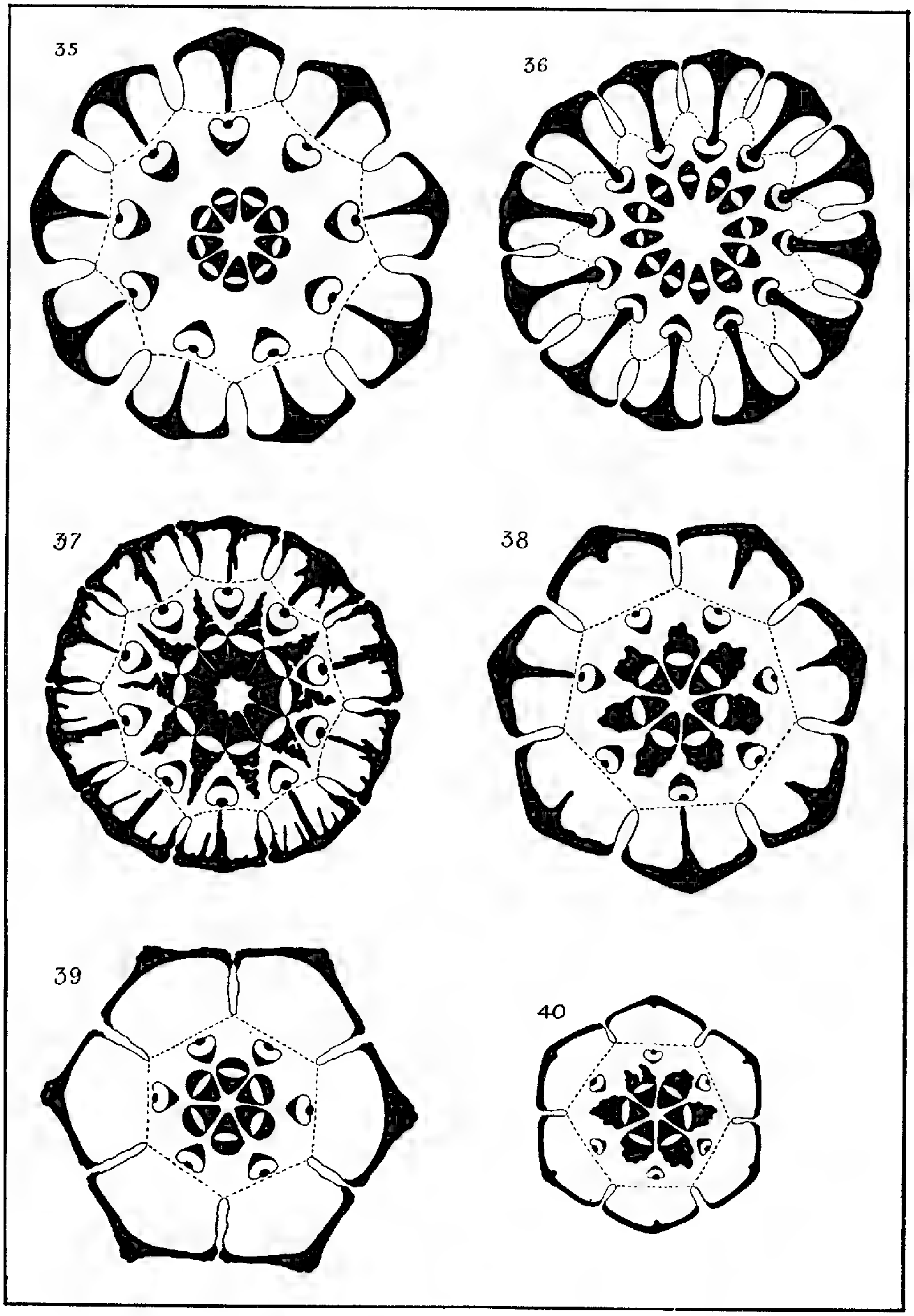
(1) *"Stricta Type."*

With the exception of *C. Muelleriana,* all the South Australian forms belong to this type, as do also *C. rigida, C. distyla,* and *C. paludosa,* of the Eastern States. *C. stricta,* which has already been described, shows the simplest structure and thus provides a good basis for comparison.

C. lepidophloia (fig. 37) and *C. Luehmanni* (fig. 36) are more strongly lignified than is *C. stricta,* with which they show the greatest affinity. In both species the ridges are rectangular, the external face being flat or only slightly raised in the median portion. The corners which mark the entry to the groove in *C. Luehmanni* are rounded, but in *C. lepidophloia* they show angular projections of epidermal cells and cuticular masses, almost closing the furrow (cf. also *C. Fraseriana* and *C. Cunninghamiana).* With the exception of *C. Decaisneana,* the cuticle of *C. lepidophloia* is of greater thickness than that of any other examined. It shows a greater number of refringent nodules. There are many branching hairs on the ridges, the bases of which can be seen in transverse section; to these hairs the hoary appearance of the branchlets is due.

In both species the T-shaped median band of fibres is well developed, the arms showing horizontally and vertically running fibres (cf. also *C. glauca, C. rigida,* and *C. striata). C. Luehmanni* shows a median band of unusual length, and the chlorenchyma dips down in the central region. At the basal layer of the assimilatory tissue in the latter species the fibres of the hypodermal mass abut on large stone cells. These have thinner walls on the side which lies in contact with the chlorenchyma, but thicker lignified and pitted cells on the side which is in contact with the other stone cells, or with the phloem and fibres of the leaf trace. The entire leaf trace is surrounded by stone cells which possibly act as an accessory water-storage tissue.

The hypodermal mass of fibres reaches greater development in *C. lepidophloia.* Here the lateral portions of the T-shaped mass project as far as possible along the sides of the furrow without actually overlapping the stomatal region. A most distinctive feature is the breaking up of the chlorenchyma by horizontal and vertical fibres thrown out from the sides of the T-shaped mass bordering on the assimilatory tissue *(vide* Wood, 1923). Consequently there is a reduction in the amount of chlorenchyma. The transversely running fibres and these curious



Figs. 35-40. Diagrams of transverse sections of the branchlets.
Camera lucida outlines.
Fig. 35—*C. stricta*, x47. Fig. 36—*C. Luehmanni*, x18. Fig. 37—*C. lepidophloia*, x47.
Fig. 38—*C. distyla*, x50. Fig. 39—*C. Muelleriana*, x50. Fig. 40—*C. suberosa*, x50.

extensions into the assimilatory tissue give the stem a peculiar appearance in longitudinal section. Tannin is present in the epidermal cells, in the large sclerised cells, in the hypodermal fibres, in the pith and the cortex. Stone cells may occur between the leaf-trace bundle and the fibres of the ridges, otherwise the cells of this region are sclerised. The cortical and pith cells of both *C. Luehmanni* and *C. lepidophloia* are lignified and pitted. However, these pitted cells are readily distinguished from the transfusion tracheides by their different shape, and also by their less regular pitting. In these, as in many other species, cluster crystals of calcium oxalate are very prevalent in the pith, cortex, and in the lower row of the chlorenchyma. Large single crystals also occur in the pith.

The cortex presents unusual variation in *C. lepidophloia.* In the majority of specimens the cells are heavily lignified and pitted; some cells also contain tannin. The pericyclic fibres are not strongly developed, perhaps one row being present, and at the most only four. Other specimens, on the other hand, may show an extraordinary development of fibres, tapering from a wide base at the phloem region of the cauline bundles up to the groove, so that the stem is very woody indeed. The specimens that showed this structure were collected at Curnamona, Dilkera, and between Parachilna and Blinman, all in arid districts.

C. Luehmanni has a group of pericyclic fibres somewhat larger than that of *C. stricta* in connection with each cauline bundle, but not reaching the development that many of the species of the "*Distyla* complex" have. Consequently this species is easily identified anatomically.

The central cylinder of *C. lepidophloia* is characterised by the presence of very small medullary rays, so that the phloem and xylem masses appear continuous. In the adult stem the rays are diffuse and consequently very insignificant, a point which has diagnostic value in separating the wood from that of *C. glauca.*

The remaining species of the "Stricta type" that have been investigated are *C. striata, C. rigida, C. distyla* (fig. 38), *C. paludosa,* and *C. pusilla.* All these species are closely related, and thus have a similar anatomical plan, the individual differences being slight. It is somewhat difficult to distinguish between the anatomy of *C. striata* and *C. rigida* except by the greater angularity of the ridges of the latter, whilst *C. distyla* is only identified by its small size. *C. paludosa,* its variety *robusta,* and *C. pusilla* have the same anatomical type, but stand apart from the other species by reason of their flatter ridges which produce the terete branchlets.

In all of these six forms the usual T-shaped median band is present, but reaches varying levels of development in different individuals. Frequently it extends down to the base of the ridge, tapering as it runs inward, to a single row in thickness; sometimes it runs down as a wide band. It may not extend to the base of the ridge, thus not completely dividing the chlorenchyma. In *C. rigida,* occasionally, the fibres are extensively developed, the arms of the T, with their horizontally running fibres, occupying almost half the thickness of the ridge; usually in such specimens the pith and cortex are heavily lignified and stone cells occur in the vicinity of the leaf trace. In *C. paludosa,* its var. *robusta,* and *C. pusilla* the median band may extend without interruption to the leaf trace where it unites with the group of fibres above the leaf trace.

As a general rule, the cortex and pith are parenchymatous in *C. striata, C. rigida,* and *C. distyla,* but may show lignification, whilst in *C. paludosa,* var. *robusta,* and *C. pusilla,* both tissues are invariably lignified. Stone cells may occur at the base of the chlorenchyma in these forms as in *C. rigida.*

All these six species are characterised by the presence of large rounded groups of pericyclic fibres above the cauline bundles, thus making them readily distinguishable from *C. stricta* and *C. Luehmanni.* On the inner side of each cauline bundle in *C. striata,* as in *C. stricta,* is a small group of fibres.

(2) "*Muelleriana Type.*"

The second type of anatomy is characterised by the absence of the T-shaped median band of fibres in the ridges. Five species of this type have been investigated: *C. Muelleriana, C. nana, C. thuyoides, C. suberosa,* and *C. Baxteriana.* Of these the last two show the greatest resemblance to the "Stricta type," and link on to that group through *C. Fraseriana* and *C. distyla.*

C. Muelleriana (figs. 39 and 41) shows 5 to 7 pentagonal ridges, the external face of the ridge having a very distinct obtuse angle. The median angle of the ridge is marked, lengthwise, by projecting epidermal cells and their thick cuticular covering. Underneath the epidermal cells of the ridges are one of two layers of hypodermal fibres, but no median band is present, and the chlorenchyma fills the whole of the ridge. The cortex is frequently lignified and the pith is invariably

41

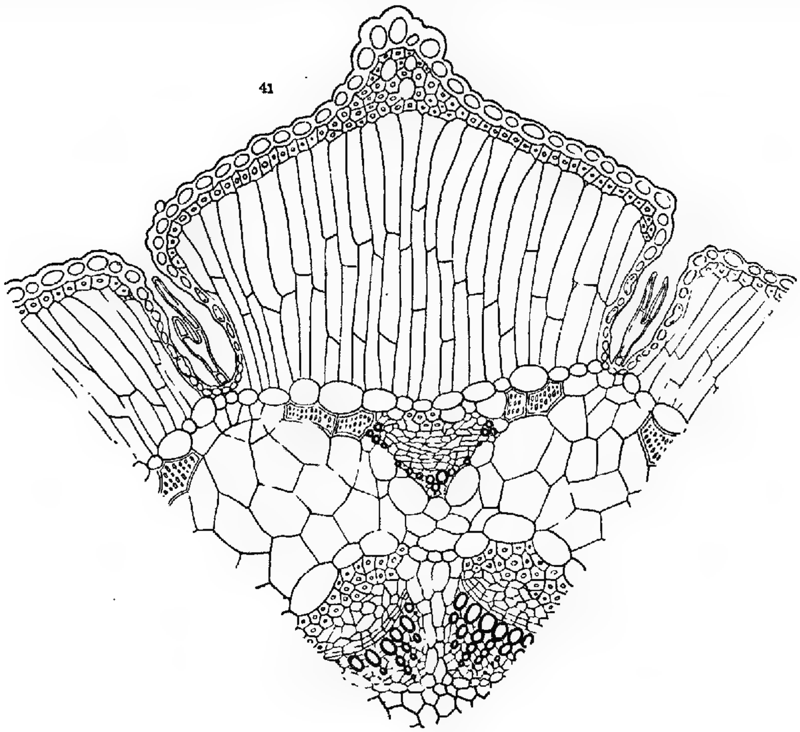


Fig. 41.

Transverse section of the assimilatory branchlet of *C. Muelleriana,* Miq., showing the ridges without any median band of fibre. x210. Camera lucida outlines.

so. The vascular bundles show a small group of pericyclic fibres, and appear to be more concentrated towards the centre, reducing the size of the pith.

C. suberosa is essentially of the same type (fig. 40), but shows the rudiments of a median band of fibres, frequently small, but sometimes reaching almost half-way down the ridges. No individuals have been seen in which it extends further. This species differs from *C. Muelleriana* in having a large mass of pericyclic fibres above the stem bundles; these masses sometimes reach to the groove.

Since I have been unable to study more than two specimens of *C. Baxteriana* it is unwise to discuss its anatomy; however, the forms examined differ in no way from *C. suberosa,* but can be easily distinguished from *C. Muelleriana,* the species with which it would most likely be confused, by the presence of the large group of pericyclic fibres as in *C. suberosa.*

Thus there are, as in the "Stricta type," species which have a well-defined T-shaped mass of fibres extending to the base of the ridges, such as *C. Luehmanni* and *C. lepidophloia*. There are also those in which, occasionally, the median band may not extend to the level of the groove as in *C. stricta*, *C. striata*, *C. rigida*, *C. distyla*, and *C. Fraseriana*. The last two seem to link on to the "Muelleriana type" through *C. suberosa* and *C. Baxteriana* (which show merely a slight projection of the fibres from the hypodermal mass into the ridges) to *C. nana* and *C. Muelleriana*.

The lack of fibres dividing the ridges cannot be due to ecological conditions, since in many areas in South Australia species of both types of structure grow side by side. The presence or absence of this band is a point that has value in tracing the affinities of this group. It has been helpful in placing *C. Muelleriana* and *C. Baxteriana*, species which have been related to *C. distyla*. It can now be said definitely that both these species lie much nearer to *C. suberosa*.

In conclusion, my grateful thanks are due to Professor T. G. B. Osborn for his constant help and encouragement during the progress of this work. I wish also to extend my thanks to Mr. J. M. Black for his valuable advice; to Professor J. B. Cleland, Mr. F. J. Paltridge, and others who have assisted me in the collection of material; to the Director of the Royal Herbarium at Kew for his great kindness in permitting me to examine type specimens; and also to the authorities of the Herbaria of Sydney and Melbourne, at whose hands I have received many courtesies. The photo., pl. xiii., was kindly taken by Mr. G. Samuel, M.Sc., of this department.

IX. Summary.

1. The "*Distyla* complex" of the *Casuarinaceae* has been studied; it has been found that there are 7 species and 1 variety confused as *C. distyla*.

2. The history of these species is reviewed in order to trace the origin of this confusion.

3. *C. distyla*, Vent., is absent from South Australia, but occurs in Victoria and Tasmania. The species regarded as *C. distyla* in Sydney is *C. rigida*, Miq., which was for many years merged with the former. *C. rigida* is recorded from Tasmania, New South Wales, and Queensland. In South Australia four shrubby species occur: one, *C. Muelleriana*, has been restored; two, *C. pusilla* and *C. striata*, are new species; and the fourth has been made a variety of *C. paludosa*. *C. Baxteriana* occurs in Western Australia.

4. The structure of the male flower, and also the anatomy of the branchlets, has been of great assistance in the work. Two types of anatomy are described for the species investigated, and the structure of the species of the "*Distyla* complex" and of the other South Australian species is described.

Literature Cited.

Adamson, R. S., and Osborn, T. G. B.—
On the Ecology of the Mount Lofty Ranges, South Australia. Trans. Roy. S. Austr., xlviii., p. 102, 1924.

Aiton—
*Hortus Kewensis, iv., 310, 1789.

Baker, R. T.—
Proc. Linn. Soc., 1899.

Bentham, G., and Mueller, F. von—
Flora Australiensis, vol. vi., London, 1873.

*Denotes publications not available to the author.

BLACK, J. M.—
Flora of South Australia, Parts 1 and 2, Adelaide, 1922.
Additions to the Flora of South Australia. Trans. Roy. Soc. S. Austr., vol. xliii., p. 350, 1919.
BORNET—
In Decaisne and le Maout: A System of General Botany, 1873.
BOODLE, L. A., and WORSDELL, W. C.—
On the Comparative Anatomy of the Casuarinaceae, with Special Reference to the Gnetaceae and the Cupuliferae. Ann. Bot., viii., 1894.
CAMBAGE, R. H.—
Notes on the Native Flora of New South Wales. Proc. Linn. Soc. N.S. Wales, xxxvi., 1901.
DE CANDOLLE, A. P.—
Prodromus Florae Novae Hollandiae, xvi., 2, pp. 332-344, 1864-1868.
CLELAND, J. B., and BLACK, J. M.—
South Australian Naturalist, vol. vi., No. 2, Feb., 1925.
DE CORDEMOY, H. J.—
Contribution a l'étude de la Morphologie, de l'Anatomie comparée, de la Phylogénie et de la Biogéographie des Casuarinées.
Revue Général de Botanique, tom. 35, 1923.
DIELS, L., and PRITZEL, E.—
Fragmenta Phytographiae Australiae occidentalis, 1905.
FORSTER, J. R. and J. G. A.—
*Char. Gen., 103, t. 52, 1775.
HOOKER, J. D.—
Flor. Tasm., i., 348, 1860.
LABILLARDIÈRE, J. J.—
Novae Hollandiae Plantarum Specimen, Paris, 1806.
LEHMANN—
Plant Priess., vol. 1., pp. 639-643, 1844.
MIQUEL, F. A. G.—
Reviso critica Casuarinarum in Verh. K. Nederl. Instit. I., xiii., 1848.
†Neder. Kruidk. Arch., iv., 1859.
Flora, Nos. 2 and 3, 1865.
MUELLER, F. VON—
Frag. Phytog. Austr., Melb., vol. vi., 1867-68, p. 19.
Frag. Phytog. Austr., Melb., vol. x., 1877-78.
Journ. of Bot., vol. xv., 1877, Melb. (Giles' Exped.).
MUELLER, F. VON, and TATE, R.—
Trans. Roy. Soc. S. Austr., pt. 3, vol. xvi., 1896 (Elder Exped.).
MORINI, F.—
Anatomia del frutto delle Casuarinee. Ricerche anatomiche sull'embrione. (Memorie della R. Accad. delle Scienze dell' Instituto di Bologna, serie 5, t. 1, 1890.)
Contributo all'anatomia del caule e della foglia delle Casuarinee *(Ibid.,* serie 5, t. iv., fasc. 4, 1894.)

*Denotes publications not available to the author.

†Publications not available to the author, but from which descriptions of species have been obtained.

Contributo all'anatomia del caule e della foglia delle Casuarinee Gimnostome *(Ibid.,* serie 5, t. v., 1895).

Contributo all'anatomia della radice delle Casuarinee *(Ibid.,* serie 5, t. vi., fasc. 2, p. 369.)

OTTO and DIETRICH—

*Garten-Zeitung, 1841, 20 and 21.

RUMPHIUS—

*Herb. Amboin., tom. iii., p. 87, t. 58, 1755.

SPRENGEL—

*Syst. Veget., tom. iii., 1826.

TATE, R.—

A Handbook of the Extra-tropical South Australia, Adelaide, 1889.

TEPPER, J. G. O.—

Proc. Roy. Soc. S. Austr. Several papers.

VENTENAT, E. P.—

†Plantes nouvelles et peu connues, pag. et tab. 62, 1803.

WILSON, H. W.—

Studies on the Transpiration of some Australian Plants, with Notes on their Leaves. Proc. Roy. Soc. Vict., xxxvi., 1924.

WOOD, J. G.—

On the Transpiration in the Field of some Plants from the Arid Portion of South Australia, with Notes on their Physiological Anatomy. Proc. Roy. Soc. S. Austr., xxiii., 1923.

EXPLANATION OF PLATE XIII.

Variation in size and shape of the cones in six species collected from the localities given below.

Row 1.—*C. striata,* n. sp.: a, Echunga; b and c, Encounter Bay; d, Belair; e and f, Aldgate. (Coll. E. D. M.)

Row 2.—*C. rigida,* Miq.: a, Sydney (J. B. Cleland, 1909); Echo Pt. (E. D. M., 1925); c, Narrabeen (E. D. M., 1925); d and e, Echo Pt. (E. D. M., 1925); f, Centennial Park (E. D. M., 1925).

Row 3.—*C. distyla,* Vent. All cones collected from Cheltenham, Victoria. (E. D. M., 1925.)

Row 4.—*C. paludosa,* var. *robusta,* n. var. All cones collected at Mt. Compass. (E. D. M., 1925.)

Row 5.—*C. pusilla,* n. sp.: a, b, c, d, e, Encounter Bay (J. B. C. and E. D. M.); f, Monarto South (J. B. C., 1926).

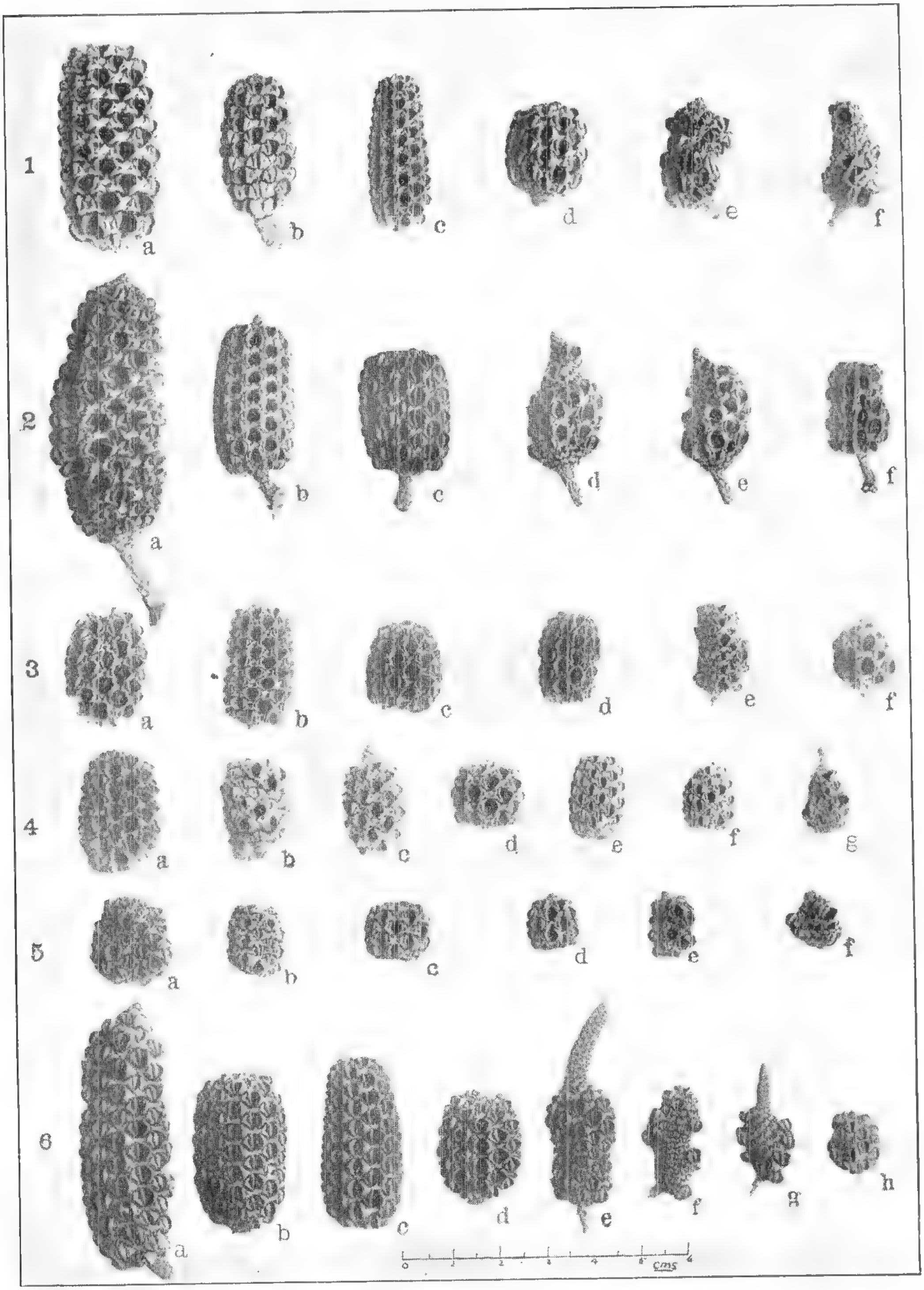
Row 6.—*C. Muelleriana,* Miq.: a, Happy Valley (J. B. C., 1927); b, c, d, e, Belair (E. D. M., 1925); f, Humbug Scrub (P. Hossfeld, 1927); g, Belair (E. D. M., 1925); h, Coonalpyn (J. B. C., 1926).

Photo by G. Samuel.

---

*Denotes publications not available to the author.

†Publications not available to the author, but from which descriptions of species have been obtained.



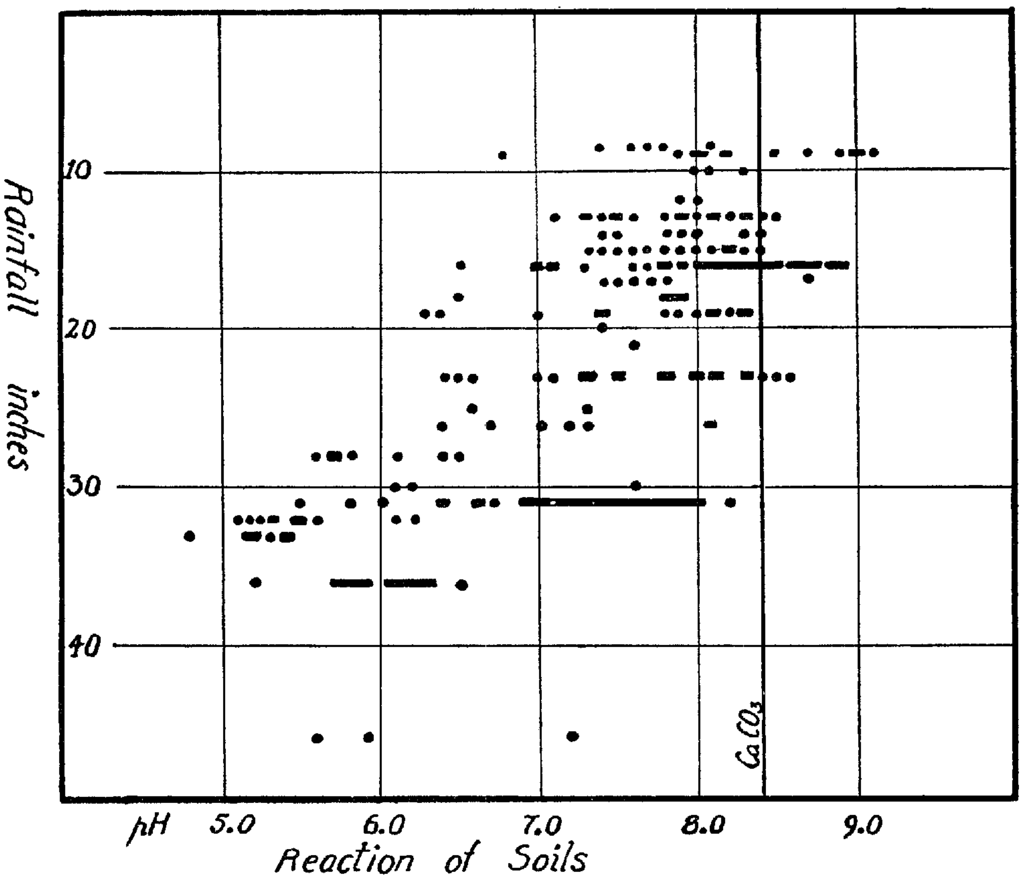
Gillingham & Co. Limited, Printers, Adelaide.

THE REACTION OF SOUTH AUSTRALIAN SOILS.

By James Arthur Prescott, M.Sc., Professor of Agricultural Chemistry, University of Adelaide.

[Read September 8, 1927.]

Since the foundation of the Waite Institute, early in 1925, a number of soil samples have been collected representative of some of the more important soil types occurring in South Australia. All the samples received and indexed have been examined for reaction, using the hydrogen ion concentration as determined by Bijlmann's quinhydrone electrode. In the earlier determinations a suspension



Illustrating the general relationship between the reaction of typical South Australian surface soils and the average rainfall.

of three-parts water to one of air-dried soil was used, but more recently a one to one suspension has been adopted following the technique recently recommended by E. Bijlmann and S. Torborg-Jensen (Trans. of the 2nd Commission of the Intern. Soc. Soil Science, B. 236, 1926). The records include a series of determinations of forest soils by Mr. M. R. Jacobs, and a further series of miscellaneous

soils by Mr. H. N. England. The series of samples is by no means complete, but it is fairly representative of a wide range of rainfall conditions throughout the agricultural zone of the State, and no useful purpose would be served in delaying further publication until a larger number of soils have been examined.

The records are presented statistically in the form of a distribution table which brings out all the essential facts as to locality, rainfall, and soil reaction —Tables 1 and 2. The term surface soil, generally speaking, refers to the A horizon of the soil profile, usually within the top 9 inches. It will be seen that there is a limit on the acid side which is governed by rainfall conditions, and that,

TABLE 1.

Reaction of South Australian Soils. Distribution Table showing Number of Soils falling into each Reaction Group. Reaction expressed as mean pH in each Group.

Locality.	Rainfall Inches.	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3
Koonamore	8														1	1	2								
County Hamley	9											1						3	2		1	1	5	1	
Nullarbor	10																	1	1	1					
Berri	12																	2							
Arno Bay	12																		1						
Hundreds of Bookpurnong and Mindarie	12							1							2	1		1	3	3	1				
Hundred of Bandon	13													1		1		3	2						
Mypolonga	14														1	1	1								
Kimba	14																			2					
Nunjikompita	14																	1	1						
Hundred of Marmon Jabuk	15														2	2	2	2	3	2					
Pinnaroo	16													1				1	4	4	2	5	2		
Hds. of Koongawa, Cootra, Barwell, Ulyerra	16										1		2	1	1	1	3	3	6	4	4	2			
Lameroo	17															1						1			
Mallala	17															1	2								
Caltowie	17														1										
Roseworthy	18																1	2							
Booborowie	18										1														
Rochester	18																1	1							
Georgetown	19																	1							
Kangaroo Island	19									2			1		2		1	1	3	3					
Spalding	20														1										
Riverton	21															1									
Reynella and Morphett Vale	23									1	1		1	1	1	1	2	1	1	2	1				
McLaren Vale	23										1				2	1		2	1	1	1				
Auburn	24										1				1										
Glen Osmond	26											1	1										1		
Penola	27									1				1	1				1						
Mount Pleasant	28					1	2	1	1	1															
Angaston	28										1														
Blackwood	29								2																
Millicent	29															1									
Macclesfield	31					1	1	1					1												
Mount Gambier	31									2	2	1	4	5	5	5	2	3	1						
Mount Crawford	32			2	3	3			1																
Mount Barker	32								1																
Hundred of Myponga	33	1		2	3																				
Kuitpo	36			1			6	2	6	3	1			1											
Mount Lofty	46						1	1						1											

TABLE 2.

Reaction of South Australian Soils. Distribution Table showing number of Subsoils falling into each Reaction Group. Reaction expressed as mean pH in each Group.

Locality.	Rainfall Inches.	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3
Koonamore	8																1	1		1					
County Hamley	9																			1	6	5	6	3	2
Nullarbor	10												1					2	2	1	2	3			
Berri	12																	1	1	1					
Hundreds of Bookpurnong and Mindarie	12											1				1	1		4	6	4	3	4		
Hundred of Bandon	13															1	2		1	4	1			1	
Mypolonga	14														1	3	1		1						
Hundred of Marmon Jabuk	15																			1	1	3	7		
Pinnaroo	16																					4	7	11	1
Hds. of Koongawa, Cootra, Barwell, Ulyerra	16														1		1	2		5	8	4	2	1	1
Lameroo	17																					1	1		
Roseworthy	18																		1			1			
Georgetown	19																	1	1						
Kangaroo Island	19							1				1				1		1		6	1	1			
Riverton	21																1	1							
Reynella and Morphett Vale	23								1		1	2			2	2		1		4	1	1			
McLaren Vale	23											2	1	1		2		2	1	2					
Glen Osmond	26													2		1									
Mount Pleasant	27											1													
Angaston	28						1																		
Blackwood	29										1														
Millicent	29																	1							
Macclesfield	31					1			1		1	1													
Mount Gambier	31										1	2	1	1	1	2	1	1							
Mount Crawford	32				1	1	2																		
Mount Barker	32									1															
Hundred of Myponga	33	2		2	2	2	1					1													
Kuitpo	36			2	1	7	10	8	2	2			1												
Mount Lofty	46						1	1	1																

generally speaking, truly acid soils do not occur with a rainfall of much less than 20 inches. The most acid soils in the State are in swamp areas under high rainfall conditions, such as the Myponga soil with a reaction of pH 4·7.

The alkaline side of the range shows some very interesting features. The reaction of calcite in equilibrium with the carbon dioxide of the atmosphere is in the neighbourhood of pH 8·4, which, with a few exceptions, is approximately the limit of alkalinity of the surface soils. Many of the subsoils derived from the mallee formations, both on Eyre's Peninsula and in the Murray areas, as well as from the far west coast, south of the Nullarbor Plain, have a high alkalinity with an extreme limit of pH 9·3. These high values have been checked against the hydrogen electrode, and there is reason to suppose that they are substantially correct, although further comparison would be desirable. Recent analyses in this laboratory, by Mr. C. S. Piper, using the method of base exchange, show that these highly alkaline soils have their reactive fractions partially saturated with sodium. Examination of the aqueous extracts for salt content further indicates the presence of free carbonate ions.

In many cases the soils are derived from formations rich in calcium carbonate, and even under conditions of fairly high rainfall such soils and subsoils are more alkaline than those derived from formations less rich in lime. Typical cases occur

at Mount Gambier and in the vineyard soils of Reynella and McLaren Vale, south of Adelaide.

The general relationship between rainfall and soil reaction is summarised diagrammatically in fig. 1.

An important series of soils not included in the tables is that from the swamps of the Lower Murray. These peaty soils are in general relatively acid, although the rainfall is only about 14 inches.

The following table gives the range of reaction of such of these swamps as have been examined:—

TABLE 3.

Reaction of surface soils and subsoils of Lower Murray peaty swamps, at Mobilong, Mypolonga, and Monteith. Number of samples with given pH values.

Reaction pH.	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4
Surface Soils	1	2		1					1	2	1			2		2		2		1	1
Subsoils				1		1		1	2					1	2	3					

All the black peaty soils of South Australia are not necessarily acid—a group of heavy black soils frequently known as "Bay of Biscay" soils in the neighbourhood of Adelaide, on account of the difficulty in securing suitable foundations for building purposes—are usually more alkaline than the corresponding red soils. Such soils at the Waite Institute, Reynella, Morphett Vale, and McLaren Vale have reaction values of pH 8·0-8·2. The swamp soils of the South-Eastern Districts are also probably mainly alkaline, one at Penola having a reaction value of pH 8·1.

The general relationship between rainfall and soil reaction, indicated above, finds a parallel in recent observations made in Java by O. Arrhenius ("Een Orienteerend Onderzoek over den Zuurgraad van de Suikerrietgronden op Java"—Sugar industry research station, Java, 1927, No. 6). The soils of eastern Java, which has a semi-arid climate, are much more alkaline than those of western Java, which is much more humid. An even better parallel is afforded by Italian observations by U. Pratolongo. Italian soils are usually acid in the regions of high rainfall and alkaline in the regions of low rainfall. (Milan, 1923, quoted by O. Arrhenius: Kalkfrage, Bodenreaktion und Pflanzenwachstum, Leipzig, 1926.)

As a supplement to the hydrogen ion concentration, the modified Comber test (Journ. Agric. Sci., 12, 370, 1922) has been applied in all cases using aqueous 5 per cent. potassium salicylate. There is an overlap between the positive and negative reactions, but, generally speaking, the neutral point, pH 7·0 divides the two classes; a few positive cases appearing with soils as alkaline as pH 7·5, and very few negative cases with soils slightly on the acid side down to pH 6·5.

The results are summarised in Table 4. All soils outside the range of reaction indicated are entirely negative or positive.

TABLE 4.

Relationship between the reaction of soils and the Comber test, giving the number of soil samples.

Soil Reaction pH.	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0
Positive Comber Test	6	21	8	16	5	9	7	6	11	6	5	7	2	4	7	1	3	3	2	2	2				
Negative Comber Test										1	1	1	4	1	3	6	4	9	12	10	17	6	19	17	26

CONTRIBUTIONS TO THE ORCHIDOLOGY OF AUSTRALIA.

By R. S. Rogers, M.A., M.D., F.L.S.

[Read September 8, 1927.]

Sarcochilus dilatatus, F. v. M., in Fragm. i., 191. This species which belongs to § *Eu-sarcochilus,* was included by Bentham under *S. olivaceus,* Lindl., but appears to me sufficiently distinctive to be worthy of retention in the Census of Queensland plants. A small quantity of moist material supplied by Rev. H. M. Rupp, of Paterson, New South Wales, has been compared with the type in the National Herbarium, Melbourne, and the following descriptive notes of the flower will supplement the original description by the Baron.

Dorsal sepal markedly spathulate; the lamina or dilated part somewhat acute, 3-nerved, rhomboidal, brownish-green; stipes linear, pale in colour, splashed with red spots; entire segment about 8 mm. long. Lateral sepals adnate to the long basal projection of column, porrect below the labellum, very distant from other segments, dilated at the base, about equal in length and similar in other respects to the dorsal sepal. Petals rather shorter, about 7 mm. long, narrower throughout than the sepals, bluntly spathulate, similar in coloration to the other segments, together with the dorsal sepal erect behind the column. Labellum white, 3-lobed; lateral lobes erect, exceeding the column and clasping the latter with their posterior borders, very broadly oblong, hardly falcate, apex pure white, very blunt and rounded, basal part with red striae on the inside and orange-brown markings anteriorly on the outside; middle lobe very small, short, and blunt, forming the narrow arc of a circle with entire margins; spur rather short and blunt, but alternating towards the apex, its entrance with a conical callus on each side arising from the base of the lateral lobes, and behind on the posterior wall a somewhat bluntly triangular recurved process; posterior wall with orange and brownish markings.

The plant was cultivated by Mr. Rupp in Paterson, New South Wales.

Queensland. Moreton Bay, W. Hill; about 50 miles west of Brisbane, F. A. Weinthal.

It differs from *S. olivaceus,* Lindl., in its smaller flowers, in the shape of its sepals terminally dilated into a rhomb, and with relatively long linear stipes, whereas these segments are linear obovate in *S. olivaceus;* likewise in the lateral lobes of the labellum, which are broadly oblong with wide rounded oblique apices, but in *S. olivaceus* are much wider at the base, narrowing gradually into a distinctly falcate apex.

Prasophyllum acuminatum, Rogers, n. sp. Caulis gracillimus, ad 17 cm. altus, supra medium bractea foliosa linearis subulata. Inflorescentia spicata, laxiuscula, circiter 1·25-3·0 cm. longa. Flores 6-13, badii cum lineis purpureis striati. Sepalum dorsale ovatum, erectum, cucullatum, acuminatissimum, 3-nervium, marginibus ciliatis, circa 4·5 mm. longum, 1·75 mm. latum. Sepala lateralia elongata, patentia, sub-gracilia, divaricata, lanceolata, cum glandulis apicibus, liberum, concava, circa 5 mm. longa. Petala triangularia, erecta, acuminata, marginibus ciliatis, sepalo dorsali breviora, 3-nervia, 3·5 mm. longa, 1·0 mm. lata. Labellum unguiculatum, ovatum, apice acuminata recurva, marginibus ciliatis, circa 2·5 mm. longum, 1·25 mm. latum, 3-nervium, in dimidio inferiore lamina interiore crassa atropurpurea auctum. Mucrona antherae elongata, teres, circa 0·5 mm. longa. Laciniae columnae erectae, ciliatae, circa

1·5 mm. longae, bifidae; segmentum anterius elongatum subulatum, segmento posteriore brevissimo latissimo.

Stem very slender, up to 17 cm. high, with a leafy linear subulate bract well above the middle. Flowers in a moderately lax spike of about 6-13, dark reddish-brown, striated, with purple nerves. Dorsal sepal ovate, erect, cucullate, very acuminate, with 3 distinct longitudinal nerves and sometimes also 2 indistinct marginal ones, margins ciliated, about 4·5 mm. long, 1·75 mm. in widest part. Lateral sepals free, elongated, spreading, rather slender, not gibbous, divaricate, lanceolate, with a gland at each apex, concave above, about 5 mm. long. Petals triangular, erect, markedly acuminate, striated, with 3 distinct longitudinal nerves, shorter than the dorsal sepal, about 3·5 mm. long, 1·0 mm. wide, margins ciliated. Labellum on a movable claw, ovate, apex acuminate much recurved, margins ciliate, about 2·5 mm. long, 1·25 mm. wide, 3-nerved, upper surface of lamina glabrous, a dark purple thickened inner plate extending beyond the middle. Anther with an elongated terete point about 0·5 mm. long. Lateral appendages of column erect, ciliated, about 1·5 mm. long, notched; anterior segment elongated, subulate, posterior segment very short, wide, and rounded.

New South Wales. Alum Mountain, Bulladelah, H. M. Rupp, May, 1923; Paterson, H. M. Rupp.

As the name implies, all floral segments of this species are acuminate, and with exception of the lateral sepals all have ciliated margins. A thickened ovate inner plate occupies the posterior half of the lamina, the apex of the lip is uncinate, and the anther has a conspicuously long terete point. The relationships of the species will be dealt with later on.

Prasophyllum Ruppii, Rogers, n. sp. Planta gracillima, circa 8-25 cm. alta, supra medium caulis bractea subulata. Inflorescentia spicata, laxiuscula, circa 1·25-3·5 cm. longa. Flores minuti, 4-18, atro-purpurei, sepalis lateralibus saepe galbanis, sessiles. Sepalum dorsale erectum, cucullatum, late ovatum, circiter 3 mm. longum, apice acutum, marginibus breviter ciliatis. Sepala lateralia leviter gibbosa, patentia, divaricata, oblongo-lanceolata, circa 3·5 mm. longa, 1·0 mm. lata, basibus oblique connata. Petala erecta, acuminata, circa 2·0 mm. longa, 0·75 mm. lata, marginibus breviter ciliatis. Labellum unguiculatum, oblongo-ovatum, apiculatum, patens, planiusculum, apice non recurva, in medio leviter canaliculatum utrimquesecus callo papilloso longitudinale, circa 2·5 mm. longum, 1·1 mm. latum. Columna brevis, anthera apice subulata, rostellum excedens; laciniae laterales latae, bifidae, antheram excedentes, marginibus anterioribus minute ciliatis, chelis fere aequantibus. Stigma anguste ovatum.

A slender species, about 8-25 cm. high, with a sheathing subulate bract well above the middle of the stem. Inflorescence a spike with about 4-18 minute sessile flowers, the lateral sepals being often a yellowish-green. Dorsal sepal erect, cucullate, widely ovate, 3-nerved, about 3 mm. long, acute at the apex, with shortly ciliated margins. Lateral sepals slightly gibbous, obliquely united at their bases, spreading, divaricate, oblong-lanceolate, about 3·5 mm. long, 1·0 mm. wide, no gland at the apex. Petals erect, triangular, acuminate, about 2·0 mm. long, 0·75 mm. wide, margins shortly ciliate. Labellum on a movable claw, oblong-ovate, apiculate, rather flat, spreading, not recurved at the apex, slightly channelled along the middle with a slight longitudinal papillose thickening on each side of this depression, about 2·5 mm. long, 1·1 mm. wide, margins shortly ciliate. Column short; anther with a fine subulate point, higher than the rostellum; lateral appendages dark reddish-brown, wide, bifid, higher than the anther; the 2 chelae nearly equal in length, the posterior one wider than the anterior; anterior margin minutely ciliate. Stigma narrowly ovate.

New South Wales. Paterson, H. M. Rupp, Feb., 1927.

Like the preceding species, all floral segments are ciliated with the exception of the lateral sepals. The segments, however, are much less acuminate and the flowers are much smaller. It has, too, a very different labellum which is rather flat, somewhat blunt, not recurved at the apex, and without the inner thickened plate, which is present on the lamina of *P. acuminatum.* The lateral appendages are likewise quite differently shaped to those of the latter species, and the anther-point is shorter and of a different type.

Prasophyllum Nublingii, Rogers, n. sp. Planta gracillima, circa 11-27 cm. alta, supra medium caulis bractea foliosa subulata. Inflorescentia spicata, laxiuscula, circa ad 5·5 cm. longa. Flores circa 5-20, parvi, badii vel subvirides. Sepalum dorsale ovatum, acuminatum, cucullatum, apice recurvum, 3-nervium, circa 4 mm. longum, 2 mm. latum, marginibus breviter ciliatis. Sepala lateralia patentia, divaricata, leviter gibbosa, concava, basibus breviter connata, 3-nervia, circa 5 mm. longa. Petala ovato-lanceolata, longe acuminata, erecta, 3-nervia, circa 3·5 mm. longa, 0·8 mm. lata, marginibus breviter ciliatis. Labellum unguiculatum, subrectangulare, ad basim angustius, breviter apiculatum, planum, apice non recurvum, circiter 4 mm. longum, marginibus breviter ciliatis; lamina callis duobus carnosis parallelis papillosis elevatis ultra medium labelli conjunctis instructa, ad apicem lineis radialibus atropurpureis ornata. Columna brevis, circa 1·5 mm. longa; anthera incumbens, acute mucronata; laciniae laterales antheram leviter superantes, bifidae, chelis fere aequantibus, marginibus anterioribus minute ciliatis. Stigma late ovatum.

A slender plant about 11-27 cm. high, with a subulate leafy bract above the middle of the stem. Inflorescence a somewhat lax spike, with about 5-20 small reddish-brown or greenish flowers. Dorsal sepal ovate, acuminate, cucullate, recurved at the apex, 3-nerved, about 4 mm. long, 2 mm. wide, the margins shortly ciliate. Lateral sepals spreading, lanceolate, divaricate at an angle of about 60°, slightly gibbous, concave, shortly connate at the base, 3-nerved, nearly 5 mm. long. Petals ovate-lanceolate, longly acuminate, erect, about 3·5 mm. long, 0·8 mm. in widest part, 3-nerved, margins shortly ciliate. Labellum on a mobile claw, somewhat rectangular, narrower at the base and widening towards the apex, shortly apiculate, flat, not recurved at the tip, margins shortly ciliate, about 4 mm. long, 2 mm. wide; lamina with 2 raised fleshy parallel papillose dark longitudinal bands coalescing and widening in front and terminating slightly beyond the middle of the lip, decorated towards the apex with dark purple radial veins. Column rather short; anther incumbent with a very acute mucrone, shorter than the lateral appendages, but a little higher than the rostellum; lateral appendages bifid, the chelae almost equal in length, anterior margins minutely ciliate.

New South Wales. National Park, E. Nubling, March 22, 1927.

The shape of the flat labellum, rectangular at the base, widening towards the front, with its peculiar double callosity and radial veins on the lamina, is quite distinctive, and easily separates this from other ciliated species.

In addition to the three species of *Prasophyllum* described here, 8 others showing evidence of ciliation in one or more floral segments have been published. The distribution of the ciliation forms a basis for the division of this difficult little group. It is more frequently met with on the inner whorls than on the outer one. For example, *it has never been observed on the lateral sepals* and is *never confined solely to the dorsal sepal,* whereas in only two instances has the lip been found unaffected, and in one of these the margins are finely and sharply toothed. It is frequent on the paired petals and paired lateral appendages of the column. In the case of the lip it is almost exclusively marginal, and only in one instance has the surface of that organ been involved in the process. In the other segments it is entirely marginal. These marginal hairs are relatively short in all species except *P. fimbriatum* and *P. Archeri,* in which cases they are long and

shaggy, forming a fringe. In the following table the segments stated to be ciliate are the *only ones* involved in the process:—

Labellum and lateral sepals quite glabrous.	
Appendages of column minutely ciliated, lateral sepals gibbous, anther point short	*P. viride*
Petals minutely ciliate, lateral sepals not gibbous, anther point very long	*P. filiforme*
Labellum with ciliated margins, lateral sepals glabrous.	
Lateral appendages of column ciliate	*P. intricatum*
Petals ciliate	*P. Woollsii*
Petals and lateral appendages ciliate	*P. reflexum*
Dorsal sepal and petals ciliate.	
Margins of lip shortly ciliate, its surface covered with long hair	*P. eriochilum*
Margins of lip fringed with long hairs, surface glabrous.	
Lamina linear-oblong, often dilated at end	*P. fimbriatum*
Lamina broadly-oblong, contracted rather abruptly into a short sharp recurved point	*P. Archeri* (1)
All segments, except lateral sepals, shortly or rather shortly ciliate.	
Lip ovate, very acuminate, *much recurved at apex*, with dark purple ovate inner plate	*P. acuminatum*
Lip oblong-ovate, rather flat and blunt, papillose thickening each side middle line, not recurved at apex	*P. Ruppii*
Lip subrectangular, widening from base forwards, abruptly contracted to an apiculum, flat, not recurved, with 2 elongated rough calli united in front in middle of lamina ..	*P. Nublingii*

Goadbyella, Rogers, nov. gen. Flores parvi, spicati, inversi. Sepalum dorsale (inferum) erectum, integrum, ecucullatum; lateralia latiora, libera, oblonga, truncata, patentia. Petala erecta, angusta, integra, sepalo dorsali subsimilia. Labellum (superum) sessile, patens, obcuneatum, apice emarginatum vel 2-lobatum, basi et apicem versus callosum. Columna longiuscula; inferne gracilis, exalata; apice dilatata, biauriculata. Anthera erecta, conspicue mucronata. Stigma prominens, ovatum vel cordatum.

Herbae terrestres, glabrae, tuberibus parvis. Folium unicum; lamina teres, basi breviter aperta et cum vagina clausa continuua. Species 1 adhuc nota, incola Australiae occidentalis.

This genus differs from *Microtis*, R. Br., with which it is most closely related, in its reversed flowers, slender and somewhat elongated column, its narrow noncucullate dorsal sepal and its wide truncate lateral sepals.

G. gracilis, Rogers, nov. sp. Species terrestris, gracillima, glabra, usque ad 37 cm. alta. Folium basim inflorescentiae bene excedens. Flores numerosi, parvi, 5 mm. longi, inversi, galbani, in spica densiuscula, infra pedicellati, supra sessiles; bracteae ovatae, acuminatae, circiter 3 mm. longi, sepalum dorsale aequantes. Ovarium brevissimum. Sepalum dorsale erectum, anguste oblongum vel oblongo-cuneatum, apice obtusissimum, 1-nervium, incurvum, circa 3 mm. longum; lateralia patentia, libera, oblonga, truncata, in dimidio inferiore marginibus integris deinde crenulatis cum callis ornatis, 3-nervia, circiter 4 mm. longa, 1·75 mm. lata. Petala erecta, linearia, paulum falcata, obtusissima, columnam subaequantia, 1-nervia, circa 2 mm. longa. Labellum sessile, patens vel subpatens, circa 4·25 mm. longum, basi oblongum marginibus integris, deinde in lobos rotundatos duos dilatatum marginibus crenulatis cum callis glandulosis ornatis; lamina in dimidio inferiore lineis parallelis elevatis duabus instructa, apicem versus calloso-tuberculato. Columna circiter 2 mm. longa, subgracilis, apice dilatata; auriculis oblique oblongis, apicibus rotundatis, insolenter longis. Anthera erecta, longe mucronata. Stigma conspicue ovatum vel cordatum.

Plant about 37 cm. high, very slender. Leaf-lamina about 15 cm. long reaching well above the base of the spike; fistula a little below the middle of the scape.

(1) The lateral appendages of column are sometimes minutely ciliate in this species.

Inflorescences not fully expanded in my specimens. Flowers *reversed*, numerous, greenish-yellow, small, about 5 mm. long, rather distant and pedicellate below, much closer and sessile above. Flower bract usually sheathing the dorsal sepal and about the same length, ovate, acuminate, about 3 mm. long. Ovary very short. Dorsal sepal narrowly oblong or oblong-cuneate, very blunt at the apex, 1-nerved, incurved over the column, about 3 mm. long. Lateral sepals spreading below the labellum, free, oblong, truncate; margins of the lower half entire, thereafter very crenulate and fringed with calli; the distal part of the upper surface more or less ornamented with groups of calli; 3-nerved, about 4 mm. long, 1·75 mm. wide. Petals erect, linear, slightly falcate, about 2 mm. long, very blunt, 1-nerved, nearly equal to the column. Labellum sessile, spreading or sub-patent, about 4·25 mm. long; oblong at the base with entire margins, then expanding into two somewhat rounded lobes with margins crenulate and fringed with glandular calli; lamina 3-nerved, with 2 raised parallel lines in the lower half and a group of glandular calli near the middle of the expanded portion. Column about 2 mm. long, somewhat slender, narrow, and not winged below, expanded abruptly at the apex; the auricles long and oblique, oblong with rounded apices. Anther erect, with a conspicuous mucrone. Stigma prominent, ovate or cordate.

Western Australia. Pindalup, in jarrah forest; Mr. P. Barwise, Nov. 1926.

For this species which constitutes the type of a new genus, I am indebted to Colonel B. T. Goadby. Pindalup is situated in the south-western corner of the State, on the Hotham Valley branch line, about 30 miles east of Pinjarra.

The plant forms an interesting link between *Prasophyllum*, R. Br., and *Microtis*, R. Br., both of which it more or less resembles in habit. Its differences from species of the latter genus have already been stated, and from the former it is readily distinguished by the shape of the labellum, and especially by the very different column. The lateral sepals are broad truncate and very ornate, in strong contrast to the simplicity of the same segments in members of the above genera.

Caladenia Audasii, Rogers, n. sp. Planta terrestris, gracilis, ad 20 cm. alta. Caulis subhirsutus, in medio bractea laxa oblonga acuta circiter 2·0 cm. longa. Folium in meo specimine absens. Flos solitarius, magnus, flavus, fere glaber, circiter 9·0 cm. in diametro; ovarium densissime hirsutum, cylindrico-cuneatum, circa 1·0 cm. longum; pedicellum gracillimum, circa 3·5 cm. longum; bractea floralis pedicellum amplexans, acuta, 2·4 cm. longa. Sepalum dorsale in meo specimine imperfectum, anguste lineare, basi retractum, incurvatum (?). Sepala lateralia patentia, inferne dilatata, deinde in caudis elongatis filiformibus pubescentibus gradatim contracta, 5-nervia, circa 6·0 cm. longa, 4·0 mm. lata; caudae circa 2·6 cm. longae. Petala anguste lanceolata, reflexa (?), 3-nervia, 4·0 cm. longa, 2·5 mm. lata. Labellum unguiculatum, indivisum, ovatum, circa 1·6 cm. longum, 1·0 cm. latum, marginibus integris; parte apicali cuneata, sparsim punctata, leviter crenulata, recurva; calli lineares, 6-seriati, leviter ultra medium laminae terminantes. Columna incurva, circa 1·7 cm. longa, basi bicallosa, superne latiuscule alata. Anthera obtusa.

Species terrestrial, slender, up to 20 cm. high. Stem rather hairy, a loose oblong acute bract about 2 cm. long in the middle. Leaf wanting in my specimen. Flower solitary, large, yellow, about 9·0 cm. in diameter; ovary very densely hairy, cylindrical-cuneate, about 1·0 cm. long; pedicel very slender, about 3·5 cm. long; floral bract embracing the pedicel, acute, about 2·4 cm. long. Dorsal sepal incomplete in my specimen, narrow-linear, retracted at the base, incurved (?). Lateral sepals spreading, dilated below, thereafter gradually contracted into very long pubescent filiform caudae, 5-nerved, about 6·0 cm. long, 4·0 mm. wide; caudae about 2·6 cm. long. Petals narrowly lanceolate, apparently reflexed, 3-nerved, 4·0 cm. long, 2·5 mm. wide. Labellum on a very narrow movable claw,

undivided, ovate, about 1·6 cm. long, 1·0 cm. wide, margins entire; the apical part cuneate, sparsely dotted, slightly crenulate, recurved; calli linear in 6 rows, ending a little beyond the middle of the lamina. Column incurved, about 1·7 cm. long, 2 yellow calli at the base, rather widely winged above. Anther quite blunt.

Victoria. Mt. McIvor, near Bendigo. Collector unrecorded, also month of collection in 1896. Forwarded from the National Herbarium, Melbourne, for determination by J. W. Audas, whose name it bears. Type in National Herbarium, Melbourne.

This species occupies a taxonomic position midway between *C. Patersonii,* R. Br., and *C. clavigera,* Cunng. From the former it differs in its entire labellum, in its relatively longer column, and in the colour of its flowers. From the latter it is easily distinguished by the size and colour of the flowers, which greatly exceed those of *C. clavigera,* and by the presence of 6 rows of calli on the labellum.

Caladenia radialis, Rogers, n. sp. Species gracilis, circa 15-25 cm. alta. Folium anguste lineare, acutum, basi amplexicaule, villosum, circa 5-15 cm. longum, 4-6 mm. latum. Flores 1-2, majusculi, lutei et badii, lineis atris in segmentis et labello, 6-7 cm. diametro; ovarium densissime hirsutum; pedicellum gracillimum, hirsutum, circa 1·8 cm. longum. Segmenta basi lanceolata vel dilatata, deinde in caudis filiformibus glanduloso-pubescentibus attenuata, subsimilia, lineis badiis striata. Sepalum dorsale erectum, incurvum, 3-nervium, circa 3·0-3·5 cm. longum. Sepala lateralia petalaque paulo longiora, 3-5 nervia, patentia. Labellum gracillime unguiculatum, subovatum, circa 1·3 cm. longum, 9-10 mm. latum, apice multo recurvum, marginibus vulgo integris rarius leviter serratis; lamina nervis atris radialibus ornata; calli lineares, curvi, 6-seriati, conferti, prope medium laminae terminantes. Columna erecta, incurva, circa 1·1 cm. longa, prorsus alata, ala supera latinscula cum lobo inferiore obtuso, basi non bicallosa. Anthera obtusissima.

Leaf narrow-linear, acute, clasping the stem at the base, villous, about 5-15 cm. long, 4-6 mm. wide. Flowers 1 or 2, rather large, yellow and reddish-brown, with dark lines on the segments and labellum, 6-7 cm. in diameter; ovary very densely and shortly hairy; pedicel slender, about 1·8 cm. long. Segments somewhat similar, lanceolate or dilated at the base, then narrowing to glandulose-pubescent filiform caudae, striated with reddish-brown lines. Dorsal sepal erect, incurved, 3-nerved, about 3·0-3·5 cm. long. Lateral sepals and petals a little longer, 3-5-nerved, spreading. Labellum on a slender movable claw, somewhat ovate, about 1·3 cm. long, 9-10 mm. wide, much recurved at the apex, the margins usually entire, more rarely slightly serrate; lamina decorated with dark radial nerves; calli yellow, linear, golf-stick type, densely crowded in 6 rows on the lower half of the lamina, ending about the middle. Column erect, incurved, about 1·1 cm. long; winged throughout, but widely so just below the anther, these upper wings being furnished with a blunt inferior lobe; no yellow calli at the base. Anther without a mucrone, extremely blunt.

Western Australia. Dowerin, E. H. Ising, Sept. 1, 1926; Beverley, Dr. F. Stoward, Sept. 13, 1913.

This species replaces the plant in Western Australia hitherto regarded as conspecific with *C. clavigera,* Cunng. Its lip differs considerably from that of the Eastern species, not only in shape, but also in the presence of 6 rows of densely crowded calli and a number of dark radial lines. Its column is also quite differently winged, has a very blunt anther without a mucrone, and is without the usual double yellow calli at the base. The segments of the perianth are not clavate.

Pterostylis robusta, Rogers, n. sp. Herba terrestris, gracilis, glabra, circa 5-20 cm. alta. Folia radicalia stellata, vulgo 6 vel 7, obtusa, late ovata

vel elliptico-ovata, longiuscule petiolata; in planta florida folia caulina, alterna, basi amplexicaulia, latiuscule lanceolata, acuminata, vulgo 4 vel 5 (bractea florali inclusa), in magnitudine summum versus crescentia, aliquando ad 5 cm. longa. Flos viridis, striatus, aliquanto magnus, solitarius. Galea circa 3·2 cm. longa, apice gradatim arcuato-incurva; sepalum dorsale acumine brevi subtili instructum. Labium inferius erectum; laciniis longe filiformibus, galeam multo superantibus. Labellum irritabile, mobile unguiculatum, fere strictum, lanceolatum, acumine acuta gradatim contractum, columnam leviter excedens; lamina circa 15 mm. longa, in medio linea elevata longitudinali, basi appendice lineari multo curva penicillata. Columna erecta, circa 16 mm. longa, lobo superiore alae acuta, lobo inferiore oblongo obtuso marginibus introrsis ciliatis.

Slender, glabrous, about 5-20 cm. high. Radical leaves (not present in the flowering plant) stellate, usually 6 or 7, obtuse, widely ovate or elliptic-ovate, with somewhat long and slender petioles; in the flowering plant leaves cauline, alternate, clasping at the base, rather widely lanceolate, acuminate, usually 4 or 5 including the floral bract, increasing in size from below upwards, sometimes attaining 5 cm. in length. Flower green with deeper green longitudinal stripes, rather large, single. Galea about 3·2 cm. long, gradually curved forward at the apex; dorsal sepal furnished with a short slender point rarely exceeding 4 mm. long. Inferior lip erect, its segments longly filiform, embracing and much exceeding the galea. Labellum irritable, on a movable claw, practically straight, lanceolate, tapering into an acute but not acuminate point, in the erect position very slightly exceeding the column; the lamina about 15 mm. long, traversed in the middle by a raised longitudinal line, with a much curved linear penicillate appendage at the base. Column erect, about 16 mm. long, the upper angle of the wing acute, the lower lobe oblong-obtuse with inturned ciliated margins.—*P. praecox*, Lindl., var. *robusta*, Ewart and Sharm., Proc. Roy. Soc. Vict., xxviii., 1915, p. 231, t. 27, fig. 7; Bentham in Fl. Austr., vi., p. 359, *P. reflexa* (partly); Rogers, *P. reflexa*, in Black's Fl. S. Austr., Part I., 1922, p. 151; Pescott and Nicholls, Vict. Nat., xlii., 1925, p. 62, pl. ii., *P. reflexa*.

Victoria. Widely distributed.

South Australia. Widely distributed.

Western Australia. Apparently coastal. Between Perth and Fremantle, Col. B. T. Goadby, July, 1927; Swanborne, near Perth, Col. Goadby, July 7, 1927.

Apparently with some hesitation, this plant was included by Bentham in Brown's species *P. reflexa*. It differs from the latter, however, in its shorter stem, wider leaves, and relatively short straight labellum which does not protrude through the sinus of the lower lip, as in the case of Brown's plant. This latter species appears to have been correctly interpreted by R. D. Fitzgerald in his "Australian Orchids," vol. i. (*P. reflexa*, fig. A), where the lamina of the lip is gradually contracted into a long narrow curved acute point, greatly exceeding the column in length and conspicuously protruding from the sinus. His figures B and C in the same plate represent, in my opinion, *P. revoluta*, R. Br., a plant with a much larger flower, but a very similar labellum. Brown, in fact, describes the labella of these two species in identical words. In both of these plants from New South Wales, the galea is much longer at the apex and more acuminate than is the case in *P. robusta*. The new species is evidently a near relative of *P. alata*, (Labill.) Reichb. f., but the latter is a more slender plant, with much smaller bract-like leaves, exceedingly translucent flowers considerably smaller in size, greyish in colour, and striated with reddish-brown. The labellum, which is reddish-brown, is very similar in shape, perhaps a trifle longer and a little less acute. The mucrone of the galea is even shorter than that of *P. robusta*, and the radical leaves are less obtuse.

AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS.—No. 6.

By J. BURTON CLELAND, M.D.

[Read October 13, 1927.]

This paper is a continuation of previous ones, of which the last, No. 5, appeared in these Transactions and Proceedings, vol. xlviii., 1924, pp. 236-252. The species dealt with are given numbers consecutive with those in the previous papers. Colour tints when specifically noted in capital letters are based on Ridgway's "Colour Standards and Colour Nomenclature," references to the plates therein being given. Following the example set by a number of other mycologists, Latin descriptions of the new species described have not been prepared.

SUMMARY OF CONTENTS.

WHITE-SPORED AGARICACEAE.

455. *Amanita angustispora*, n. sp. Pileus $1\frac{1}{4}$ to 2 in. (3·2 to 5 cm.) in diameter, irregularly convex, then nearly plane or with centre depressed, viscid when moist, subfibrillose round the edge, whitish with a slightly biscuity-brown tint in the centre or with a pale-chocolate or greyish-brown tint. Gills just reaching the stem to adnexed or nearly adnate, moderately close, not ventricose, edges serrate in one collection, $\frac{1}{4}$ in. (7 mm.) or more deep, white with a slight cream tint. Stem 2 to $2\frac{1}{2}$ ins. (5 to 6·2 cm.) high, equal, moderately stout to moderately slender ($\frac{3}{8}$ to $\frac{1}{2}$ in., 10 to 12·5 mm. thick), mealy and gill-marked above the definite dependent white superior or nearly median ring, slightly fibrillose below, solid, base bulbous, 1 in. (2·5 cm.) long, $\frac{3}{4}$ in. (1·9 cm.) thick, rounded below or with a conical root. Volva sheathing, ample, whitish. Smell slightly strong. Spores elliptical, narrow for the length, 10 to 13×5·5 to 6 μ. Deeply rooting in sandy soil. Encounter Bay, May, 1926, August and September, 1927. Kinchina plants

(August, 1925) are probably the same, but the pileus is noted as white only, the ring is median, and the bulbous base showed no definite volva, spores 13×6·5 μ.

456. *Amanita straminea*, n. sp. Pileus up to $2\frac{1}{4}$ ins. (5·6 cm.) in diameter, convex, then nearly plane with the centre slightly irregularly depressed, surface dull, mealy when young, becoming smooth, white. Gills adnexed, moderately close, alternate ones at the periphery short, up to $\frac{3}{8}$ in. deep, near Straw Yellow (pl. xvi.). Stem up to $2\frac{1}{4}$ ins. (5·8 cm.) high, rather slender ($\frac{3}{8}$ in., 1 cm., thick above), nearly equal, base somewhat bulbous, somewhat mealy, solid, white. Ring evident, dependent, membranous, subdistant, white. Volva not obvious, evidently friable. Flesh rather thin, white. Spores elliptical, with an oblique apiculus, definitely slightly coloured yellow, 11 to 13×7·5 μ. On the ground under shrubs. S.A.—Kinchina, June 8, 1926; Encounter Bay.

457. *Armillaria colossa*, Fr., var. *australis*, var. nov. Pileus 3 ins. (7·5 cm.) or more in diameter, at first irregularly convex, then expanding to irregularly plane or upturned, surface fibrillose-matt with some more superficial fibrils, Clay Colour (pl. xxix.), to Sayal Brown (pl. xxix.), towards the centre sometimes much darker. Gills sinuate, nearly free, moderately close, $\frac{1}{4}$ in. (6 mm.) deep, ventricose, short ones interposed at the periphery, Light Pinkish Cinnamon (pl. xxix.), when old spotted with reddish-brown. Stem 2 ins. (5 cm.) high, $\frac{1}{2}$ in. (1·2 cm.) or more thick, usually attenuated downwards, fibrillose striate, marked with gill lines above, solid, at first pallid with rusty stains, then tinted with Ochraceous Tawny (pl. xv.). Ring-marked when young, median, pallid, then brownish. Flesh-white, a little reddish under the cuticle, when old becoming brownish, especially in the stem. Flesh of stem continuous with that of the pileus. Spores subspherical, smooth, 7 to 7·5 μ, 9×7·5 μ. Subcaespitose in an imperfect ring at the base of an old Eucalyptus trunk. S.A.—Mount Lofty, July 1925.

These plants agree fairly closely with Tab. 60 (*Tricholoma colossa*, Fr.) in Bresadola's Iconographia Mycologica now being published, but differ in the spores (Bresadola, 8 to 10×5 to 6μ) and in the tendency to spotting of the gills. Rea (Brit. Basidiomycetae) places the species under *Armillaria* and gives the spores as 6 to 7×5 to 7 μ. It seems advisable to give the Australian plants a varietal name and to place them under *Armillaria*.

458. *Armillaria muscicola*, n. sp. Pileus up to 1 in. (2·5 cm.) in diameter, broadly conico-convex to convex, umbonate, frosted with granules or fine warts and slightly rugose, Yellow Ochre to Ochraceous Tawny (pl. xv.). Gills adnate to adnexed or sinuately adnexed, moderately close, creamy-white to pure white. Stem up to $1\frac{1}{2}$ in. (3·7 cm.) high, covered with yellowish-buff granules up to a little below the gills, forming here a more or less definite ring, browner than Tawny to Buckthorn Brown (pl. xv.). Spores elliptical, oblique, not thick-walled, 5·5 to 6·5×3·2 to 3·5 μ. Amongst moss on shady banks, etc. S.A.—Greenhill Road, July, 1921 (Miss Buxton, Watercolour No. 10, Formalin Sp. No. 324); Mount Lofty, June, 1921; National Park, July, 1923.

An albino plant was found near a normal one on the Greenhill Road in August, 1922. The pileus was white with a faint tinge only of buff, the stem white, smooth, and slightly striate above the superior ring, mealy-white below, and the spores 6·5×4 μ.

459. *Mycena subvulgaris*, n. sp. Pileus $\frac{3}{8}$ to $\frac{7}{8}$ in. (10 to 21 mm.) in diameter, convex, umbilicate, striate, margin at first straight, near Fuscous (pl. xlvi.), young plants between Buffy Brown and Olive Brown (pl. xl.). Gills adnate to adnato-decurrent, in four tiers, the second tier reaching nearly half-way to the stem, the third tier very short, whitish, then with a slight greyish tint. Stem $1\frac{1}{2}$ to 2 ins. (3·7 to 5 cm.) high, slender, very glutinous, slightly strigose at the base, hollow, the lower portion paler than the pileus (near Drab, pl. xlvi.), whitish above. Flesh

of pileus very thin, dark coloured like the surface, with a triangular cavity below the umbilicus. Spores narrow, 8×3·7 μ. Gregarious to subcaespitose. Amongst leaves and small sticks on the ground. S.A.—National Park, May 28, 1927. (Formalin Sp. No. 389.)

Apparently the Australian representative of *Mycena vulgaris*, (Pers.) Fr., but tending to be larger and darker in colour, without a definite papilla, and with the pileus not definitely viscid. Cooke's Illustrations (pl. 191) are not very like our plants.

460. *Clitocybe brunneo-ceracea*, n. sp. Pileus up to 1½ in. (3·7 cm.) in diameter, thin, the edge turned in when young, irregularly convex with an umbilicus, then moderately depressed, sometimes gibbous in the depressed centre, the edge faintly striate, innately silky-fibrillose, when moist near Buffy Brown (pl. xl.) and moist looking, waxy-semitranslucent, markedly hygrophanous, drying to pallid or dingy whitish with a buffy tint, the drying commencing from near the centre, the centre sometimes remaining for a while buffy brown shading to dark brown. Gills moderately decurrent, close, narrow, many short, edges rather thick, sometimes with venose buttresses between the gills, pallid greyish-brown, much paler than Drab (pl. xlvii.). Stem up to 1½ in. (3·7 cm.) high, usually slender, sometimes flattened, fibrillose, extensively hollow, coloured like the pileus but paler. Flesh under the pileus moist-looking brown, in the centre of the pileus white, in the stem pale brown. Spores narrow, 5·5 to 6×2·2 μ. Cystidia not seen. Slight phosphorus-like smell. Amongst dead leaves and sticks. S.A.—National Park, July.

Resembles *C. paraditopa*, Clel. et Cheel, but lacks the strong wattle scent and is less robust. The specific name refers to the semi-translucent waxy (or soapy) appearance of the brownish pileus when moist.

461. *Clitocybe peraggregata*, n. sp. Sometimes merismatic, the upper surfaces irregularly infundibuliform with wavy and irregular edges showing lobes, villous, excentrically or almost laterally attached to a stout common branching stem from which the rather fan-shaped pilei spread out. Pileus 1 to 2 ins. (2·5 to 5 cm.) in diameter, irregularly convex, often distorted, edge a little turned in, punctate pruinose and breaking up on the surface into minute furfuraceous granules or wart-like prominences, the granules darker coloured, the surface appearing as if partly dusted with soot, colour Drab (pl. xlvi.) or lighter, paler round the periphery. Gills decurrent to nearly adnate, moderately close, edges a little thick, sometimes forked, whitish with a buffy tint or livid greyish. Stem short, ¾ to 1 in. (1·9 to 2·5 cm.) high, moderately stout, up to 1 in. (2·5 cm.) thick at the base, often distorted, whitish flecked with minute greyish furfuraceous scales. Spores obliquely elliptical, probably faintly tinted microscopically, 6·5 to 7·8×4·8 to 5·5 μ. Cystidia not seen. Flesh slightly greyish, that of the stem confluent and homogenous with that of the pileus. Smell slightly mealy. Densely caespitose, growing on the clay floor of a motor shed, probably from rotten wood or buried chips. S.A.—Fullarton, Adelaide, June (1922), September (1923).

Apparently related to *C. aggregata*, (Schaeff.) Fr., but differing more particularly in the pruinose-furfuraceous pileus and the short stem.

462. *Clitocybe semiocculta*, n. sp. Pileus ½ to 1 in., sometimes up to 2½ ins. (1·2 to 6·2 cm.) in diameter, at first slightly convex with inturned edge, then sometimes expanded and upturned, often depressed over the attachment of the stem, wavy, irregular and more or less lobed at the margin, when found growing usually whitish to dingy whitish or pale buffy white (Cartridge Buff, pl. xxx.) or creamy white and opaque, smooth, a little translucent when very moist, when gathered becoming Ochraceous Buff (pl. xv.) round the edge and even browner in the centre, herbarium specimens drying a dingy biscuit colour. Gills adnate to sometimes slightly decurrent, close, narrow, whitish, then creamy-white. Stem

short, $\frac{1}{2}$ to 1 in. (1·2 to 2·5 cm.) high, central to excentric or occasionally almost lateral from the position in which it may have grown, similarly often bent, slender or rather stout, equal or slightly attenuated downwards, pruinose, tough, hollow above, the colour of the pilcus. Flesh thin, equally attenuated outwards. Spores nearly subspherical, 3·5 to 4×2·5 to 2·8 μ, 4 μ. Sometimes caespitose. Attached by fluffy-white mycelium to the undersides of thick sheets of fallen or stripped bark and fallen wood on the ground beneath Eucalypts, or round the base of stumps, the pilei often emerging with difficulty or only found after removing superjacent litter. N.S.W.—The Rock, July, 1917. S.A.—Mount Lofty, June, 1927; National Park, August, 1927; Baker's Gully, near Clarendon, June, 1927. The specific name has reference to the frequency with which the pileus is often more or less hidden under bark and *débris*.

463. *Pleurotus subapplicatus*, n. sp. Pileus $\frac{1}{4}$ to $\frac{5}{8}$ in. (6 to 16 mm.) in diameter, convex, becoming depressed towards the attachment, at first inverted saucer-shaped, finally rather fan-shaped, a little repand, sometimes almost lobed, tomentose, strigose near the attachment when large, pallid grey. Gills moderately close, radiating from a lateral to excentric point of attachment, many short ones, grey with a fawny tint. No definite stem. Flexible, the flesh of the pileus with an upper dark gelatinous layer. Shed spores spherical, 6 to 7 μ. On an upright piece of rotting wood in a glass house. S.A.—Blackwood, April, 1927. (Formalin Sp. No. 388.)

This species differs from Rea's description (British Basidiomycetes) of *P. applicatus*, (Batsch.) Berk., more particularly in the gills being moderately close and the spores being spherical (not 7 to 9×4 to 5μ). Kauffmann (Agaricaceae of Michigan) says the gills of *P. applicatus* are subdistant, and whitish at first, then grey, and that the spores are spherical, 4 to 5 μ. These descriptions appear to refer to different species, the description of neither of which fully agrees with that of the Australian plants. The specific name *subapplicatus* has reference, however, to the obvious close relationship between our species and the American and European ones.

464. *Pleurotus cinerascens*, n. sp. Laterally attached at the apex. Pileus up to $\frac{1}{2}$ in. (1·2 cm.) in diameter, convex to cupulate, dark greyish-black, hoary round the edge, whitish and densely hoary when young. Gills radiating from an excentric point, moderately close and numerous, many short ones at the periphery, sometimes showing slight venose buttresses, grey. Flesh dark coloured, subgelatinous. Spores 6×3·5 μ; pileus clothed with cells and processes covered with lateral wart-like projections. S.A.—National Park, August, 1927, on trunk of living *Eucalyptus viminalis*, Lab.

A species evidently closely related to *P. applicatus* and *P. subapplicatus*, but characterised more particularly by the cells on the pileus, a feature not apparently recorded in *P. applicatus*, from which it also differs in the gills being moderately close and grey and in the slightly smaller spores. The shape of the spores separates it from *P. subapplicatus*.

465. *Russula purpureo-flava*, n. sp. Pileus up to $2\frac{1}{4}$ ins. (5·8 cm.) in diameter, somewhat irregular and slightly depressed, slightly sticky, cuticle peeling, Jasper Red (pl. xiii.) to purplish-red and very dark purplish-brown (Pompeian Red, pl. xiii., near Mars Violet, pl. xxxvii., in parts sometimes near Dark Vinaceous Purple, pl. xxxviii., occasionally with yellowish-brown paler areas). Gills adnate, moderately close, rather narrow, attenuated both ways, near Naples Yellow to Mustard Yellow (pl. xvi.). Stem $1\frac{1}{2}$ ins. (3·7 cm.) high, $\frac{3}{8}$ in. (10 mm.) thick above, equal or attenuated downwards, surface a little rough, pithy, pale yellowish with rosy tints to rosy, yellowish towards the base. Flesh white with yellow tinges, thin, attenuated outwards. Taste mild. Spores microscopically slightly tinted to yellowish, subsphercial pear-shaped, 7·5 to 10 μ, 8 to

$8 \cdot 5 \times 6 \cdot 5$ to $7\ \mu$. No cystidia detected on the pileus. S.A.—Mount Lofty, March and April, 1924 (Miss Buxton, Watercolour No. 14), June and July, 1921; Stirling West, July, 1927; Kuitpo (Sir Douglas Mawson).

466. *Lactarius Clarkei*, n. sp. Pileus 3 ins. (7·5 cm.) in diameter, infundibuliform, matt, reddish-fawn. Gills adnate, moderately close, pallid becoming spotted and discoloured brown. Stem short, ¾ in. (18 mm.) high, stout (9/16 in., 16 mm.), expanded towards the pileus, attenuated downwards, solid, colour of the pileus, milk white. Taste mild. Spores slightly angular, $8\ \mu$. S.A.—Mount Lofty, June, 1927. In general appearance rather resembling *Russula Floctonae*, Cld. et Cheel. From its resemblance to this *Russula* we have named it after Miss Flockton's niece, Miss Phyllis Clarke, to whom we have been so much indebted for many admirable watercolour drawings of New South Wales agarics.

467. *Marasmius alveolaris*, n. sp. Pileus ⅛ in. (3 mm.) or less in diameter, rarely more, the surface alveolar from raised ribs rimosely arranged, leaving a polygonal cell in the centre, dark honey-coloured (near Snuff Brown, pl. xxix.), the ribs darker. Gills adnate, distant, about 6 in number, with some venose elevations at the periphery forming abortive gills and buttressing folds, edges thick, pallid honey-coloured. Stem short, up to ¼ in. (6 mm.), rarely more (⅝ in., 15 mm.), slightly pruinose, whitish above, very dark brown below, abruptly entering the matrix. Spores white, narrow, oblique, with the ends drawn out and acute, 10 to $13 \times 5 \cdot 5\ \mu$, 9 to $10 \times 3 \cdot 7\ \mu$. Hairs on the pileus and stem colourless, straight with knobby or irregular swollen apices, 38 to $76 \times 7 \cdot 5\ \mu$, forming a villous coat, a few present also on the edges of the gills. On bark. S.A.—National Park, May, 1925 (Formalin Sp. No. 355) and 1927, July, 1927.

468. *Cantharellus rugosus*, n. sp. Pileus up to 1¾ ins. (4·8 cm.) in diameter, submembranaceous, irregularly convex with the centre depressed, finally often upturned, coarsely and irregularly radiately rugose, dark brown near Natal Brown (pl. xl.), drying paler near Wood Brown (pl. xl.). Gills adnate, rather narrow, often very irregular with buttresses and sometimes anastomosing folds between, when dry more vinaceous than Army Brown (pl. xl.) with a more purplish cast when moist. Stem up to 2 ins. (5 cm.) high, slender, attenuated downwards, villous, hollow, when dry near Buff Brown (pl. xl.), when moist dark brown, nearly black. Flesh very thin. Spores 7 to $9 \times 3\ \mu$, cystidia not seen. Suggestive of *Marasmius*, but not reviving when moistened. At the base of a stump. S.A.—Mylor, June, 1926.

469. *Cantharellus granulosus*, n. sp. Pileus 2 ins. (5 cm.) in diameter, irregularly convex to plane, sometimes upturned irregularly, repand, edge irregular, thin, smoky-brown from minute dark-coloured granules or warts. Gills subdecurrent, moderately close, narrow, edges rather thin, often forking towards the periphery, sometimes crinkled and with irregular veins between, creamy in colour with rusty stains where injured. Stem short, ½ in. (1·2 cm.) high, subexcentric, slender, stuffed, tough, dark smoky-brown from minute granules. Flesh of stem continuous with that of the pileus. Spores subspherical to elliptical, $9 \cdot 5 \times 7 \cdot 5\ \mu$, $7 \cdot 5\ \mu$. S.A.—On ground in a swamp, Back Valley, Encounter Bay, May, 1926.

470. *Cantharellus brunneus*, n. sp. Pileus about ⅜ to ½ in. (10 to 12·5 mm.) in diameter, submembranaceous, convex, the centre umbilicate to infundibuliform, striate to rugose-striate, edge slightly incurved when young, semitranslucent sometimes when moist, and near Sayal Brown, Snuff Brown, or Pinkish Buff (all pl. xxix.), becoming pale wood-brown and drying pallid with a brownish tint (near Light Buff, pl. xv., paler than Pinkish Buff), opaque and dull. Gills deeply decurrent, rather distant, edges thick, alternate gills short, often forked, especially in larger specimens, with narrow irregular gills at the periphery, sometimes venose on the sides, sometimes the branching leading to irregular cells at the

periphery, slightly paler than the pileus (paler than Pinkish Buff or Cinnamon Buff). Stem ½ to 1 in. (1·2 to 2·5 cm.) high, slender, equal or slightly attenuated upwards, smooth above, sometimes slightly pruinose below, usually solid, sometimes hollow, colour of the pileus. Flesh of the stem continuous with that of the pileus, pallid brown when moist, whiter when dry, cortex of the stem more cartilaginous. Spores subspherical to pear-shaped elliptical, 5·5 μ, usually 7·5×4·5 to 5·5 μ, rarely 6 to 9×3·7 to 5·5 μ. Amongst moss or short grass or on bare soil. S.A.—Greenhill Road, Mount Lofty, August, 1925; Black Hill, July, 1923; Mount Lofty, August, 1925; Morialta, May, 1925; Mylor, June, 1926; Kinchina, August, 1925; MacDonnell Bay, S.E., May, 1925.

PINK-SPORED AGARICACEAE.

471. *Leptonia virido-marginata*, n. sp. Pileus ¾ in. (18 mm.) in diameter, slightly convex with the centre dimpled, clad with small fibrillose scales, edge slightly sulcate, dark green (near Dusky Olive Green, pl. xli.). Gills slightly sinuate with a decurrent tooth, moderately distant, alternate ones short, of a Light Pinkish Cinnamon (pl. xli.) tint passing into dark green which edges the gills. Stem 2½ ins. (6·2 cm.) high, slender, flexuous, twisted, shining, finely punctate above, rather tough, flesh heterogenous from that of the pileus, hollow, dark green. Shed spores of salmony tint, microscopically angular pear-shaped, 11 to 11·5×7·5 μ, cystidia not seen. On the ground. S.A.—Mount Lofty, June.

BROWN-SPORED AGARICACEAE.

472. *Pholiota rufo-fulva*, n. sp. Pileus up to 1½ ins. (3·7 cm.) in diameter, at first conico-convex, then convex or irregularly convexo-plane, minutely fibrillose, becoming subfloccose to velvety, no striae, edge a little turned in when young, darker than Pecan Brown (pl. xxviii.) to Russet (pl. xv.), when old becoming Tawny (pl. xv.), when moist very dark maroon-brown. Gills adnate, close or a little distant, deep (up to ¼ in., 8 mm.), somewhat ventricose, with short ones at the periphery, of the colour of the pileus becoming more cinnamon and Argus Brown (pl. iii.). Stem up to 1¼ in. (3·4 cm. high), moderately slender, fibrillose, solid, when moist Kaiser Brown to Carob (pl. xiv.), drying pallid with tints of the pileus. Veil white, marked when young, rupturing to leave a marked whitish or pallid superior ring. Flesh brownish. Single or subcaepitose, the type at the base of Eucalypts. Spores yellow-brown, obliquely elliptical, 7·5 to 9·3×5·5 μ, hyphae of subhymeneal layer large. S.A.—Burnside, July, 1925 (type); Happy Valley, September, 1926 (spores 9×4·5 μ); on sandy soil, Encounter Bay, May, 1926 (edges of gills a little serrate, stem hollow, spores 9 to 10×5·6 μ).

This is possibly *P. recedens*, Cke. and Mass., recorded for Victoria, which is described as golden-tawny, at length faintly striate (which our plants are not) and with a longer stem (3 to 4 ins.).

473. *Pholiota subpumila*, n. sp. Pileus ⅝ to 1·⅛ in. (15 to 28 mm.) in diameter, convex then becoming flattened or a little depressed, umbonate when young, sometimes a little wavy, shining waxy-looking, dark tan. Gills adnate or slightly decurrent, rather triangular, rather close, watery-brown. Stem 1½ in. (3·7 cm.) high, equal or slightly attenuated upwards, fibrillose, white or with a slight tinge of the colour of the pileus. Ring subdistant, whitish, not marked. Spore mass fuscous-brown, spores microscopically yellow-brown, oblique, 8 to 9·5×5·5 μ. Growing amongst moss. S.A.—Greenhill Road, June, 1926. Closely related to *C. pumila*, Fr., but larger, stem paler, gills browner, and spores a little larger.

474. *Cortinarius (Myxamicium) ruber*, n. sp. Pileus and stem viscid. Pileus up to 2 ins. (5 cm.) in diameter, convex, then irregularly wavy and convex, subgibbous, near Dragon's Blood Red (pl. xiii.) passing into Rufous (pl. xiv.). Gills

slightly sinuately adnexed, moderately close, a little ventricose, Tawny Olive (pl. xxix.). Stem up to $1\frac{1}{2}$ ins. (3·7 cm.) high, viscid, rather short and stout, bulbous, up to $\frac{3}{4}$ in. (17 mm.) thick below and $\frac{1}{2}$ in. (1·25 cm.) above, solid or somewhat hollow, the colour of the pileus below the remains of the veil, above whitish and slightly striate, with some yellowish mycelium at the base and whitish rooting mycelial strands below. Cobwebby veil yellowish-red or red, glutinous. Flesh of the pileus white, moderately thick over the stem, thinning outwards, flesh of the stem discoloured. Spores $9{\cdot}5 \times 6{\cdot}5\ \mu$. S.A.—Kinchina, July; Belair, July (Miss Buxton, Watercolour No. 12).

475. *Cortinarius (Myxamicium) subarvinaceus*, n. sp. Pileus and stem viscid. Pileus $1\frac{3}{4}$ to $3\frac{1}{2}$ ins. (4·6 to 8·7 cm.) in diameter, convex, sometimes repand, finally irregularly upturned, edge a little turned in, sometimes substriate round the edge, very viscid, Ochraceous Tawny (pl. xv.) becoming much darker and shining in the centre. Gills adnate or subsinuate, moderately close, slightly ventricose, pallid greyish-cinnamon then Tawny Olive (pl. xxix.) and darker. Stem $1\frac{1}{2}$ to 3 ins. (3·7 to 7·5 cm.) high, stout, up to $\frac{3}{4}$ in. (17 mm.) thick, equal, mealy fibrillose, base viscid, pallid whitish becoming brownish. Flesh slightly brownish, when old becoming semitranslucent, thick over the disc, thin externally, cuticle thick and dark brown. Spores oblique with pointed ends, spore mass near Tawny Olive (pl. xxix.), 13 to $15 \times 7{\cdot}5\ \mu$. Under trees. S.A.—Stirling West, July, 1927.

Evidently a species closely related to *C. (M.) arvinaceus*, Fr., but differing in being smaller, with the gills not adnate-decurrent or "straw colour, then bright ochraceous," and the spores smaller than 15 to 17×8 to $9\ \mu$ (Rea).

476. *Cortinarius (Myxamicium) ochraceus*, n. sp. Pileus and stem very viscid. Pileus up to 2 ins. (5 cm.) in diameter, convex, repand, finally irregularly upturned, Yellow Ochre (pl. xv.), centre darker. Gills adnate, close, $\frac{1}{4}$ in. (8 mm.) deep, near Sudan Brown (pl. iii.). Stem 2 ins. (5 cm.) high, $\frac{3}{8}$ in. (10 mm.) thick, somewhat bulbous below, then equal, striate above, pallid becoming yellowish-brown. Flesh soapy looking, thick over the disc, rapidly attenuated outwards. Spores yellow-brown, $8{\cdot}5 \times 4\ \mu$. On the ground amongst leaves under trees. S.A.—Mount Lofty, July, 1927.

477. *Paxillus infundibuliformis*, n. sp. Sometimes slender, usually large and stout. Pileus up to $3\frac{1}{2}$ ins. (8·7 cm.) in diameter, irregularly infundibuliform (shallow or deep), sometimes irregularly convex or rather flabelliform when the stem is excentric, finely villous, tending to crack into rows of villi near the periphery, sometimes covered with brown to very dark brown (near Russet, pl. xv., to Mars Brown, pl. xv.) warty scales, the edge involute when young, Ochraceous Tawny (pl. xv.), becoming Cinnamon Brown (pl. xv.), or Raw Sienna (pl. iii.) or Light Cadmium (pl. iv.) or under the scales when present near Honey Yellow (pl. xxx.). Gills decurrent, often deeply so, often forking several times from near the stem, moderately close, edges a little thick, when young near Aniline Yellow (pl. iv.), becoming Sudan Brown (pl. iii.), Ochraceous Tawny (pl. xv.) or Clay Colour (pl. xxix.) and later still darker *(e.g.*, Antique Brown, pl. iii.), sometimes becoming spotted with brown. Stem up to $1\frac{1}{2}$ ins. (3·7 cm.) high, up to $\frac{1}{2}$ in (1·2 cm.) thick, relatively slender, attenuated downwards, swollen under the pileus, villous or somewhat mealy or even fibrillosely scaly, stuffed or hollow, central or sometimes excentric, pallid to the colour of the gills (base Mars Brown, pl. xv.), sometimes with a few slightly raised brown lines. Flesh pallid or turning reddish-brown when cut, then darker. Spores mummy-shaped, elongated, yellow-brown to greenish-yellow, usually 12·8 to 16, occasionally 21×4 to $7\ \mu$. Cystidia not seen. S.A.—Kuitpo, May; Mount Lofty, April to July. Vict.—Sedgwick, near Ararat, July (E. J. Semmens, No. 126), and near Bendigo.

PURPLE-SPORED AGARICACEAE.

478. *Psilocybe subaeruginosa*, n. sp. Pileus ¾ to 2 ins. (1·8 to 5 cm.) in diameter, when young conical to conico-convex, then convex, and usually a little upturned, subgibbous or sometimes with a small acute umbo, smooth, periphery a little striate, edge inturned when young, hygrophanous, pale brownish to dark brown when older, often with bluish-green blotches, drying pallid biscuity-brownish (Tawny Olive, pl. xxix., or yellower than Warm Buff, pl. xv., when dry; Dresden Brown, pl. xv.; Dusky Green Blue, pl. xx., when dry near Cinnamon Buff, pl. xxix., or paler; Saccardo's Umber to Bister, pl. xxix., when dry near Cream Colour, pl. xvi). Gills adnate to broadly adnexed sometimes with lines running down the stem, moderately close, slightly ventricose, in three series, the middle one reaching half-way to the stem, pallid smoky-brown becoming brownish-fuscous (near Natal Brown, pl. xl., when old; Snuff Brown, pl. xxix.; Fuscous, pl. xlvi). Stem tall, 2 to 5 ins. (5 to 12·5 cm.) high, equal or slightly attenuated upwards, rather slender, finely striate, mealy above, fine fibrils sometimes adherent below, base a little swollen passing sometimes into a broad mass of white mycelium, stuffed with white, sometimes hollow, cartilaginous, flesh heterogenous from that of the pileus, pallid whitish streaked with dark greyish-brown and often blotched with greenish-blue (Prussian Green, pl. xix., or a little paler; Dusky Green Blue, pl. xx.). Closed with a cobwebby whitish veil when young, occasionally leaving indefinite traces of a somewhat superior ring. Flesh of pileus whitish, of stem becoming brownish. No smell. Spores in the mass purplish-fuscous, rather elliptical, microscopically dark brown to dull purplish-brown, 11 to $14 \times 6{\cdot}4$ to 9 μ. Single or gregarious, amongst grass, once on horse-dung. S.A.—National Park, April, May, June, August; Mount Lofty, June, July; Waterfall Gully, June. Vict.—Among growth of red-gum coppice near decaying leaves and twigs near a creek, Craigie, near Ararat, June (E. J. Semmens, No. 31). N.S.W.—Fitzroy Falls, June. Apparently this same species, with an acute umbo, has been found at the base of a stump on wood or roots at Mount Wilson (June, 1915), and on a fallen trunk at National Park, N.S.W. (May, 1919; spores dark brown, $10{\cdot}5 \times 6{\cdot}8$ μ).

479. *Psilocybe stercicola*, n. sp. This tall, slender-stemmed, dung-inhabiting *Psilocybe* has puzzled us for long. From its habitat—cow and horse dung—it was evidently an introduced species, and yet it was not one of the British species (*Ps. coprophila*, (Bull.) Fr., and *Ps. bullacea*, (Bull.) Fr.) so growing. It resembled more closely *Ps. foenisecii*, (Pers.) Fr. At last we found that Kauffmann (The Agaric. of Michigan, i., p. 277) had referred an American dung-inhabiting *Psilocybe* to *Ps. uda*, (Fr.) Bat., a species described as living amongst sphagnum. Our plants agree well with his description but do not resemble Cooke's Illustration of *Ps. uda*. Though we think it very probable that our plants are the same as Kauffmann's, we do not think that they are referable to *Ps. uda*, and so we have been compelled to give them a new name.

Pileus 3/16 to (rarely) 1¼ in. (·5 to 3 cm.) in diameter, convex, subgibbous or with a small or acute umbo, then expanding, somewhat sticky when moist, edge often striate when moist, hygrophanous, when moist dark brown (near Prout's Brown, pl. xv.; Bistre, pl. xxix.; or Sepia, pl. xxix.), when dry pale brownish (Clay Colour, pl. xxix.; Antimony Yellow, pl. xv.; Pinkish Buff, pl. xxix.; or Cinnamon Buff, pl. xxix.). Gills ascending, adnate, moderately close, slightly ventricose, Fuscous (pl. xlvi.), edges sometimes paler. Stem up to 2 ins. (5 cm.) high, slender, slightly flexuose, slightly striate, slightly mealy, sometimes with woolly mycelium at the base, usually hollow, sometimes stuffed, pallid with a slight brownish tint to brownish. Spores elliptical, dark purplish brown to porphyry, 12 to $14{\cdot}5 \times 7$ to 8 μ. Always on dung (cow or horse). N.S.W.—National Park, May, July; The Spit, July; Lane Cove, May; The Oaks, June; The Rock, July;

Terrigal, June. Vict.—Ararat, May (E. J. Semmens, No. 23). S.A.—National Park, May (Miss Fiveash, Watercolour No. 7), July, August; Mount Lofty, March, July; Kuitpo, May.

480 (see i., 69, as *Ps. bullacea*). *Psilocybe coprophila*, (Bull.) Fr. We have recorded *Ps. bullacea*, (Bull.) Fr. (Journ. Roy. Soc. N.S. Wales, 1914, p. 438), and in these Transactions, for New South Wales and South Australia. The spores of the plants so recorded are, however, too large for this species, according to the measurements given by Rea (Brit. Basidiomyc., p. 365), and our plants would seem to agree closely with his description of *Ps. coprophila*. In our plants we note that the edge of the pileus is often whitish from remains of the veil, that the pileus is often slightly striate when moist, and that we have got spore measurements up to 16 μ. Our plants always grow on dung. We have the following localities additional to those given by us previously under *Ps. bullacea:* N.S.W.—Narrabri, May; Kendall, August; Junee, October. S.A.—Kinchina, July; Beaumont, August.

481. *Psilocybe subammophila*, n. sp. Pileus 1 in. (2·5 cm.) in diameter, convex, subgibbous, sometimes slightly striate when moist and a little rugulose and shining when dry, edge a little turned in when young, hygrophanous, dark brown when moist, becoming near Cinnamon Buff (pl. xxix.) Gills adnate, slightly ventricose, moderately close, becoming near Warm Sepia (pl. xxix.). Stem long, up to 3 ins. (7·5 cm.) high, slightly attenuated upwards, slender, fibrillose, solid, the lower half buried, thickened and sand-encrusted, pallid with a brownish tint. Spores fuscous, elliptical, oblique, 11 to $13 \times 5 \cdot 5$ to 6 μ, no cystidia seen. S.A.—In sandy soil, near Kinchina, May, 1926. (Formalin Sp. No. 357.) Closely related to *Ps. ammophila*, (Dur. and Mont.) Fr., differing in the longer stem, the gills adnate not subdecurrent with a tooth, the spores slightly narrower and the location sandy agricultural land, not sands on the sea-shore.

BLACK-SPORED AGARICACEAE.

482. *Psathyrella subprona*, n. sp. Pileus $\frac{1}{2}$ in. (1·2 cm.) broad, $\frac{3}{8}$ in. (10 mm.) high, conico-campanulate with an acute apex, drying an opaque pallid whitish with fine anastomosing striae, greyer when moist. Gills ascending a little, adnate, moderately close, clouded fuscous-grey. Stem 1 to $1\frac{1}{2}$ in. (2·5 to 3·7 cm.) high, slender, slightly mealy, then polished, slightly hollow, somewhat brittle, white. Flesh thin, that of the stem different in texture from the flesh of the pileus. Spores nearly black, elliptical, 15×8 μ. Usually single, in grass by the roadside. Encounter Bay, August 28, 1927. These plants differ from Rea's description of *Ps. prona*, Fr., in British Basidiomycetae in being conico-campanulate with an acute apex rather than campanulate then hemispherical, in the pileus not being pellucidly striate and obsoletely silky-atomate, and in the gills being moderately close, not distant, and in the stem not being flexuose. Recognised by its small size, regular pileus, thin flesh, pallid colour, fuscous-grey gills, nearly black large spores, and habitat amongst grass. Our plants resemble closely Cooke's Illustration, pl. 656, of *Ps. prona*.

THE FAUNA OF KANGAROO ISLAND, SOUTH AUSTRALIA.

(Under the aegis of the Fauna and Flora Board.)

No. 1.—THE CRUSTACEA.

By HERBERT M. HALE, Zoologist, South Australian Museum.

(Contribution from the South Australian Museum.)

[Read October 13, 1927.]

The species listed herein were taken on the shores of Kangaroo Island, or in the vicinity. Sir Joseph Verco, when dredging in Investigator Strait, operated off Cape Borda, off the north-western coast of the island, etc. A few species were dredged near the island by the F.I.S. "Endeavour," and were dealt with by Rathbun, Chilton, and Schmitt,[1] while Tattersall recently recorded two opossum-shrimps.[2] Many of the Crustacea enumerated were obtained during visits of officers of the Fauna and Flora Board and of the Museum. In 1926, Mr. N. B. Tindale and the author spent a month on the island, and some days were devoted to marine collecting on the north and south coasts. The Bay of Shoals, on the north coast, proved a fertile collecting ground; this bay is well protected and extremely shallow, so that at low tide a huge area of mud flat is exposed.[3] The original site of the township of Kingscote is at Reeves' Point, on the shore of the Bay; the township at Beare's Point, a mile to the south, was established in 1883 and named Queenscliffe, but for about twenty-three years this newer settlement has been known as Kingscote.

Order STOMATOPODA.

Family SQUILLIDAE.

LYSIOSQUILLA PERPASTA, Hale.

Beare's Point (type locality).

Order DECAPODA.

Family PENEIDAE.

PENEUS LATISULCATUS, Kishinouye.

Bay of Shoals (C. E. Ewens); off Marsden Point, 17 fath. ("Endeavour").

The colouration of a living specimen was as follows:—Semi-translucent, the whole body lightly dotted with violet; rostrum and antennal scales streaked and spotted with violet. Median ridge of fourth to sixth pleon segments, and median ridges of telson, almost black, narrowly margined with yellow. Posterior parts of branches of uropods blue, anterior portions delicate green; marginal hairs orange. Legs and pleopods tinged with pink; greater part of merus and carpus blue in the last three pairs of legs.

Family SYNALPHEIDAE.

CRANGON VILLOSUS (Olivier).

Beare's Point, in crevices on limestone reef (W. H. Anderson).

---

(1) Biol. Res. Endeavour, v., pt. 1, 1918; v., pt. 2, 1921; v., pt. 3, 1923; and v., pt. 6, 1926.

(2) Tatt., Rec. S. Austr. Mus., iii., 1927, pp. 242 and 249.

(3) Hale, S. Austr. Nat., vii., 1926, p. 70, fig. 1.

CRANGON PRAEDATOR (de Man).

Beare's Point (Capt. Brown and A. Zietz).

CRANGON EDWARDSI (Audouin).

Bay of Shoals, in burrows in soft mud (Hale and Tindale).

Even this small species can snap its large chela with surprising loudness. When a couple of specimens were placed in a bottle of sea-water the sharp clicks which they produced conveyed the impression that the glass had suddenly cracked. A very similar sound was made by sharply rapping the vessel with a metal tool.

CRANGON NOVAE-ZELANDIAE (Miers).

Beare's Point, under stones (A. Zietz, Hale and Tindale).

SYNALPHEUS MACCULLOCHI (Coutière).

Beare's Point, under stones (Hale and Tindale).

BETAEUS AUSTRALIS, Stimpson.

Beare's Point, under stones (Hale and Tindale).

These examples were purplish-brown dorsally, with the sides of the body and tips of the uropoda white.

Family HIPPOLYTIDAE.

ALOPE AUSTRALIS, Baker.

Smith's Bay (type loc., R. Baker); north coast (W. H. Baker).

HIPPOLYTE TENUIROSTRIS (Spence Bate).

Caradina tenuirostris, S. Bate, Proc. Zool. Soc., 1863, p. 501, pl. xl., fig. 4.
Caridina tenuirostris, Hasw., Cat. Austr. Crust., 1882, p. 183.
Hippolyte tenuirostris, Hale, Crust. S. Austr., 1927, p. 51, fig. 43.

Bay of Shoals, ½ fath., amongst *Posidonia* (Hale and Tindale).

The rostrum of this small species is slender, with two or three teeth (almost always three) on the upper margin, and usually one or two on the lower edge near

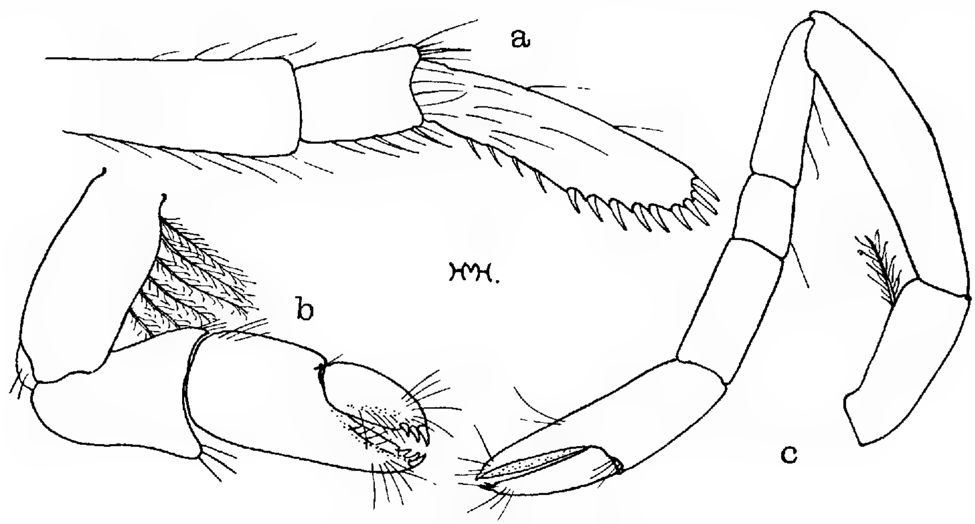


Fig. 1.

a, Third maxilliped; b, first leg, and c, second leg of *Hippolyte tenuirostris* (x 60).

the apex; sometimes ventral teeth are entirely absent. The abdomen is humped at the third segment, this geniculation being accentuated in preserved examples. The arm of the first peraeopods is about as long as the hand, which is longer than the wrist (36:26); the dactylus is slightly shorter than the palm. The wrist of the second legs is longer than the arm, with the proportions of the first, second, and third joints, 27:12:22; the hand is somewhat longer than the second and third joints of the wrist together, with the dactylus almost as long as the palm. The largest specimen examined is 12 mm. in length.

Family PALAEMONIDAE.

Leander intermedius, Stimpson.

Bay of Shoals and Beare's Point, amongst weed near shore (Hale and Tindale).

Leander serenus, Heller.

Bay of Shoals, amongst weed near shore (Hale and Tindale); Vivonne Bay, in rock pools (F. Wood Jones and E. R. Waite).

Palaemon australis, Ortmann.

Fresh-water on Kangaroo Island, no definite locality (A. Zietz).

Family PALINURIDAE.

Jasus lalandii (M. Edwards).

Vivonne Bay (Hale and Tindale).

Family PORCELLANIDAE.

Porcellana dispar, Stimpson.

Porcellana dispar, Stimps., Proc. Acad. Nat. Sci. Philad., x., 1858, p. 242 (80), and Smithson, Misc. Coll., xlix., 1907, p. 190, pl. xxiii., fig. 3; Hasw., Cat. Austr. Crust., 1882, p. 149; Miers, Zool. "Alert," 1884, p. 275, pl. xxx., fig. C; McCull., Proc. Linn. Soc. N.S. Wales, xxxi., 1906, p 40; Rath., Arkiv. f. Zool., K. Svenska Vet.-Akad., xvi., No. 23, 1924, p. 31; Hale, Crust. S. Austr., 1927, p. 82, fig. 79.

Porcellana rostrata, Baker, Trans. Roy. Soc. S. Austr., xxix., 1905, p. 260, pl. xxv., figs. 1, 1*a* and 1*b*.

Investigator Strait, 17 fath. (Sir J. Verco); Kangaroo Island (W. H. Baker).

Mr. Baker now considers that his *P. rostrata* cannot be specifically separated from *P. dispar.*

Family AXIIDAE.

Axius (Neaxius) plectorhynchus, Strahl.

Beare's Point, under stones on reef (Hale and Tindale).

As previously noted,[4] two varieties occur; both were taken on the reef.

Family CALLIANASSIDAE.

Upogebia simsoni (Thomson).

Emu Bay (R. Baker); Beare's Point (Hale and Tindale); Vivonne Bay (F. Wood Jones and E. R. Waite).

At Beare's Point this species was found burrowing deeply in the sand where pools were left by the receding tide.

Upogebia (Gebiopsis) bowerbankii, Miers.

Investigator Strait and Backstairs Passage (Sir J. Verco).

---

[4] Hale, Crust. S. Austr., 1927, p. 84.

Family PAGURIDAE.

Paguristes frontalis (M. Edwards).

Bay of Shoals and Beare's Point (Hale and Tindale); north coast (W. H. Baker and A. Zietz).

Paguristes sulcatus, Baker.

Beare's Point (Fox and Wiese).

Family DROMIIDAE.

Cryptodromia octodentata (Haswell).

Bay of Shoals (Hale and Tindale); American Beach (M. Le Ray); off Marsden Point, 17 fath., and off Sanders Bank, 28 fath. ("Endeavour").

In the Bay of Shoals small examples, without sponge or other cloak, were found in between large masses of Ascidians. One specimen taken elsewhere in the Bay, and of approximately the same size (about three-fourths of an inch in breadth), carried a piece of *Ulva* over its back.

Dromidiopsis excavata (Stimpson).

Off Marsden Point, 17 fath. ("Endeavour").

Dromia bicavernosa, Zietz.

Hog Bay (type loc., H. Bates and A. Rumball).

Petalomera lateralis (Gray).

Beare's Point, under stones on reef (Hale and Tindale).

Family HYMENOSOMATIDAE.

Halicarcinus ovatus, Stimpson.

Bay of Shoals and Beare's Point, on Algae in shallow water (Hale and Tindale); Vivonne Bay (F. Wood Jones and E. R. Waite).

Halicarcinus rostratus (Haswell).

North coast of Kangaroo Island (A. Zietz).

Elamena (Trigonoplax) unguiformis longirostris, McCulloch.

North coast (coll. ?).

Family MAJIDAE.

Naxia aurita (Latreille).

Beare's Point (Hale and Tindale); Vivonne Bay (F. Wood Jones and E. R. Waite); Backstairs Passage (Sir J. Verco).

Naxia tumida (Dana).

Vivonne Bay (Hale and Tindale).

Ephippias endeavouri, Rathbun.

South of Kangaroo Island, Investigator Strait ("Endeavour").

Eruma hispidum (Baker).

Investigator Strait (Sir J. Verco).

The five syntypes of this species are from Port Willunga, Port Lincoln, and the above locality; as the specimens are associated in the collection it is not possible to assign a definite locality to any one of them.

Huenia proteus, de Haan.

Backstairs Passage (Sir J. Verco).

The weed *Halimeda,* with which this crab is commonly associated in the tropics, has been found near the shores of Kangaroo Island.

Leptomithrax australiensis, Miers.

Beare's Point, under stones at low tide (Hale and Tindale); Cape Marsden and off Marsden Point, 17 fath. ("Endeavour").

Leptomithrax sternocostulatus (M. Edwards).

Investigator Strait, 20-30 fath. (Sir J. Verco); Cape Marsden, 17 fath., and north of Cape Borda, 40 fath. ("Endeavour").

Schizophrys aspera (M. Edwards).

Investigator Strait, 20-30 fath. (Sir J. Verco).

Paramicippa tuberculosa, M. Edwards.

Vivonne Bay (Hale and Tindale).

Family PARTHENOPIDAE.

Thyrolambrus excavatus, Baker.

Investigator Strait (Sir J. Verco).

Family PORTUNIDAE.

Ovalipes bipustulatus (M. Edwards).

Vivonne Bay, 2-3 fath. (Hale and Tindale).

Liocarcinus corrugatus (Pennant).

Investigator Strait, 20 fath. (Sir J. Verco).

Nectocarcinus integrifrons (Latreille).

Beare's Point (Hale and Tindale).

Nectocarcinus tuberculosus, M. Edwards.

Vivonne Bay (Hale and Tindale).

Family XANTHIDAE.

Megametope rotundifrons (M. Edwards).

Investigator Strait, 20-30 fath. (Sir J. Verco).

Actaea peronii (M. Edwards).

Investigator Strait, 20 fath. (Sir J. Verco); Sanders Bank, 28 fath., off Marsden Point, 17 fath., and north of Cape Borda, 40 fath. ("Endeavour").

Actaea calculosa (M. Edwards).

Investigator Strait (Sir J. Verco); north coast of Kangaroo Island (W. H. Baker); off Marsden Point, 17 fath. ("Endeavour").

Ozius truncatus, M. Edwards.

Beare's Point, under stones at low tide (Hale and Tindale); Vivonne Bay (F. Wood Jones and E. R. Waite).

PILUMNUS TOMENTOSUS, Latreille.

Beare's Point (Hale and Tindale); north coast of Kangaroo Island (A. Zietz); off Marsden Point, 17 fath. ("Endeavour").

PILUMNUS FISSIFRONS, Stimpson.

Bay of Shoals, ½ fath., on weed, and Beare's Point (Hale and Tindale); Vivonne Bay (F. Wood Jones and E. R. Waite).

ACTUMNUS SETIFER (de Haan).

Investigator Strait and Backstairs Passage (Sir J. Verco); off Marsden Point, 17 fath. ("Endeavour").

LITOCHEIRA BISPINOSA, Kinahan.

Bay of Shoals, on weed near shore (Hale and Tindale); Vivonne Bay (F. Wood Jones and E. R. Waite).

Family PINNOTHERIDAE.

PINNOTHERES SUBGLOBOSA, Baker.

Off Marsden Point, 17 fath. ("Endeavour").

Family GRAPSIDAE.

CYCLOGRAPSUS AUDOUINII, M. Edwards.

Bay of Shoals, under stones; Beare's Point, on reef; Busby Island, in holes in moist mud; Vivonne Bay, under stones on banks of Harriet River, ¼ mile from mouth, and in a cave (Hale and Tindale); American River (J. Waddy); north coast of Kangaroo Island (A. Zietz).

PARAGRAPSUS GAIMARDII, M. Edwards.

Bay of Shoals, under stones (Hale and Tindale).

BRACHYNOTUS OCTODENTATUS (M. Edwards).

Vivonne Bay, under stones on banks of Harriet River, ¼ mile from mouth, and in burrows near mouth of Harriet River (Hale and Tindale).

Juvenile examples were taken under stones, old males in the burrows; the habits of these adults are described elsewhere.[5]

ERIOCHEIR SPINOSUS (M. Edwards).

Heterograpsus spinosus, M. Edw., Ann. Sci. Nat., xx., 1853, p. 194, and Journ. Mus. Godeff., iv., 1874, p. 6; de Man, Notes Leyden Mus., xiii., 1891, p. 56, pl. iv., fig. 15; Ortmann, Zool. Jahrb., vii., 1894, p. 715.

Brachynotus spinosus, Fulton and Grant, Proc. Roy. Soc. Vict., xix., 1906, p. 19.

Eriocheir spinosus, Hale, Crust. S. Austr., 1927, p. 184, fig. 185.

Bay of Shoals, under stones on beach, and Busby Island, in holes in moist mud (Hale and Tindale).

This species is referred to *Eriocheir* in the abovementioned handbook, and a female is there illustrated. The chelipeds are short and weak in this sex, longer and much more robust in the male. The palms of adult males are not furnished with cuffs of hair as in the genotype of *Eriocheir*, but, as mentioned by de Man

---

(5) Hale, Crust. S. Austr., 1927, p. 182, figs. 183 and 184.

(ut supra), both fingers are provided with hairs on each side; these hairs are densely plumose. In some males they are arranged in tufts, in others they are very dense and resemble fur; in a few cases the clothing of the immovable finger extends backwards on to the palm for a short distance. The chelipeds are unarmed, but the merus of each ambulatory limb has a small spine near the distal end of the upper margin. The exopod of the external maxillipeds is only one-third the width of the ischium; the merus is subcordate, slightly wider than, but

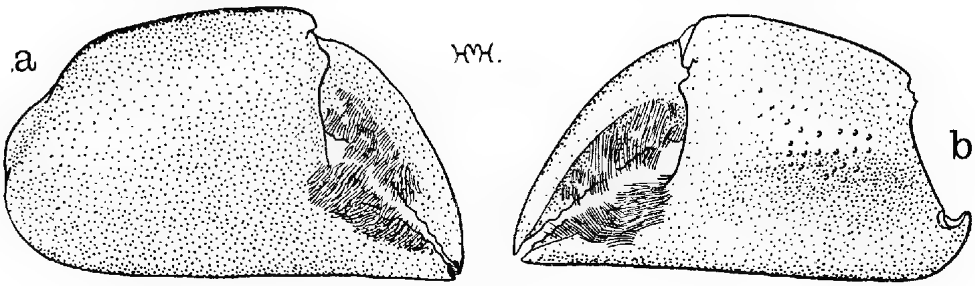


Fig. 2.

a, Outside, and b, inside of hand of adult male of *Eriocheir spinosus* with carapace 17 mm. in breadth (x 4).

only three-fourths the length of, the ischium. The largest male examined has a carapace 17 mm. in length and 20 mm. in breadth.

This little crab is common in Victoria, Tasmania, and South Australia; it is found along the banks of estuarine rivers (as well as on beaches and tidal flats), but apparently never enters fresh water above tidal influence. Mr. F. A. McNeill informs me that some specimens from "North Coast of Tasmania" labelled by Haswell "*Heterograpsus octodentatus*" are referable to *E. spinosus;* he suggests that very probably Haswell's "*Heterograpsus octodentatus,*" from Port Phillip, was also *E. spinosus.*[6]

PLAGUSIA CHABRUS (Linnaeus).

Vivonne Bay, common in shallow water (Hale and Tindale).

Family LEUCOSIIDAE.

PHILYRA LAEVIS, Bell.

Bay of Shoals, on mud in shallow water (Hale and Tindale); American River (A. Zietz), Queenscliffe (Fox and Wiese).

The habits of this species, as observed in the Bay of Shoals, are described in another paper.[7]

PHLYXIA INTERMEDIA, Miers.

Off Marsden Point, 17 fath. ("Endeavour").

Order AMPHIPODA.

Many species other than the few listed below remain to be recorded from Kangaroo Island.

---

(6) Hasw., Cat. Austr. Crust., 1882, p. 101.

(7) Hale, S. Austr. Nat., vii., 1926, p. 67.

Family LYSIANASSIDAE.

Waldeckia kroyeri (White).

Ephippiphora kroyeri, Chilt., Boil. Res. "Endeavour," v., 1921, p. 35, figs. 1*a*-1*i* (syn.).

North coast of Kangaroo Island (Capt. Brown).

This large species is not uncommon in South Australian waters; Chilton examined specimens from Bass Strait and west of Eucla.

Waldeckia chevreuxi, Stebbing.

Sanders Bank, 28 fath. ("Endeavour").

Family STENOTHOIDAE.

Stenothoe valida, Dana.

Vivonne Bay, 2 fath. (Hale and Tindale).

A specimen from the above locality is illustrated. The life colouration of examples collected was as follows:—Yellow, closely dotted with dark brown over

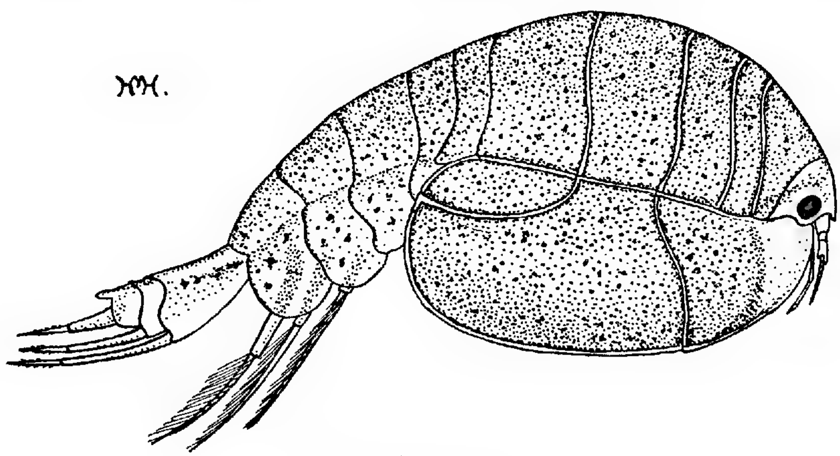


Fig. 3.
Stenothoe valida (x 16).

greater part of body; first of the visible side plates yellowish and almost transparent anteriorly, and dark brown posteriorly, the two colour areas separated by a vertical sooty marking.

Family GAMMARIDAE.

Melita fresnelii (Audouin).

Sanders Bank, 28 fath. ("Endeavour").

Ceradocus rubromaculatus (Stimpson).

Vivonne Bay (Hale and Tindale).

Family DEXAMINIDAE.

Polycheria antarctica (Stebbing).

Sanders Bank, 28 fath. ("Endeavour").

Family TALITRIDAE.

TALORCHESTIA NOVAE-HOLLANDIAE, Stebbing.

Common on beaches (Hale and Tindale).

Family PHOTIDAE.

EURYSTHEUS ATLANTICUS (Stebbing).

Sanders Bank, 28 fath. ("Endeavour").

Family JASSIDAE.

ICILIUS AUSTRALIS, Haswell.

Sanders Bank, 28 fath. ("Endeavour").

Family CAPRELLIDAE.

CAPRELLA SCAURA, Templeton.

Vivonne Bay, 2-3 fath. (Hale and Tindale).

Order ISOPODA.

Family EURYDICIDAE.

CIROLANA CRANCHII AUSTRALIENSE, Hale.

Vivonne Bay, 1 fath., on meat trap (Hale and Tindale).

Family CYMOTHOIDAE.

CODONOPHILUS IMBRICATUS (Fabricius).

Bay of Shoals (Hale and Tindale).

A free-swimming juvenile was captured. Other Cymothoid species must occur.

Family IDOTEIDAE.

EUIDOTEA PERONII (M. Edwards).

Bay of Shoals, on weed in shallow water; Beare's Point, under stones at low tide, and Vivonne Bay, 2-3 fath. (Hale and Tindale).

EUIDOTEA STRICTA (Dana).

Shores of Kangaroo Island (old collection).

EUIDOTEA BAKERI (Collinge).

Beare's Point, on limestone reef (Hale and Tindale).

Examples taken there were dark or pale green, with the body broadly margined with white, and a series of white markings on the mid-line of the thorax.

Euidotea, Collinge.

Euidotea caeruleotincta, n. sp.

♀. Non-ovigerous. Body slender, nearly eight times as long as greatest width, and very depressed. Surface slightly rugose, dull and not at all polished. Cephalon about as wide as long, almost flat and with antero-lateral angles prominent. Eyes rather large, distinctly elevated. First antennae reaching to end of second peduncular article of second antennae; second and third articles, and flagellum, subequal in length. Second antennae less than half as long as body, with the peduncle slender and much longer than flagellum; first article short, visible in dorsal view; second about three-fourths as long as third, which is subequal in length to fourth; flagellum composed of nine articles and a minute terminal style. Outer lobe of first maxillae capped with eleven strong spines, most of which are more or less denticulate, some being conspicuously comb-like

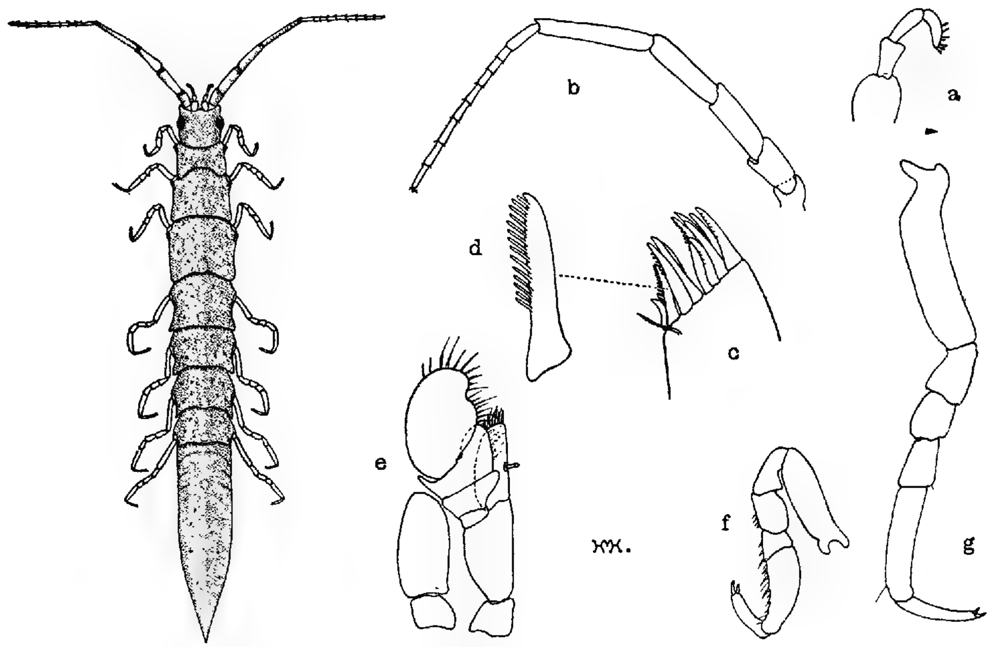


Fig. 4.

Euidotea caeruleotincta, type female (x 3) : a, first antenna (x 15) ; b, second antenna (x 8) ; c, terminal part of outer lobe of first maxillae (x 86) ; d, one of the spines from outer lobe of first maxilla (x 260) ; e, maxilliped (x 21) ; f and g, first and seventh peraeopods (x 15).

(fig. 4, d) ; inner lobe narrow, with three setose spines. Maxillipeds broad, with four-jointed palp; basis almost as long as last article (fourth and fifth fused joints of the palp), with inner lobe moderately wide, with spines at distal end; epipod about as long as basis, exclusive of inner lobe. Peraeon with a low but distinct longitudinal median ridge; each segment rather angular. First segment narrow and short, second much larger; third segment larger than any of the others; fourth to seventh segments successively decreasing in size; postero-lateral angles of all segments slightly produced backwards, those of the last four somites subacute. Coxae of first legs completely fused with first free peraeon segment; those of second to seventh legs small, scarcely at all expanded, but visible in dorsal view. Peraeopods slender, prehensile, successively increasing in length

backwards, the first pair two-thirds as long as the last. Pleon narrow, tapering to an acute apex, very flat, and with a low median ridge; unisegmentate, with a rather obscure indication of a suture across the surface near the base, and two pairs of exceedingly ill-defined short lateral furrows. Uropoda narrow, with hinder margins obliquely truncate; endopod rounded postero-laterally. Length, 23·5 mm.

Loc.—South Australia: Bay of Shoals, Kangaroo Island (H. M. Hale and N. B. Tindale). Type in South Australian Museum, Reg. No. C 869.

This species lives on the broad strap-shaped leaves of a large variety of *Posidonia australis,* which grows thickly in shallow water on the north coast of Kangaroo Island. The very flat body of the crustacean enables it to cling closely adpressed to the leaves of this plant; *Crabyzos longicaudatus* was taken in the same situation. The animal is variable in general colouration, being graminaceous, yellow or rich purplish-brown during life; some examples were beautifully mottled with the last colour, the dorsum of the pleon was crossed by four irregular pale bars, and the second antennae were broadly banded with purple. In one respect, however, all specimens agree; there is always an iridescent blue spot at the middle of the hinder part of each peraeon segment and one at the first third of the pleon.

The species of *Eusymmerus, Erichsonella, Colidotea, Synisoma,* and *Euidotea* have the palp of the maxilliped four-jointed and all segments of the pleon coalesced. In the first two genera the flagellum of the second antennae is composed of but a single joint, and in *Colidotea* the coxal plates of the second to fourth somites are completely fused with the segments. The above species is referred to *Euidotea* rather than to *Synisoma* because the pleura of the first thoracic segment are scarcely produced laterally or forwards and the head has not well-developed lateral lobes. *E. bakeri* and *E. caeruleotincta* differ from the genotype of *Euidotea* in having the body longitudinally ridged.

In a key to the South Australian genera of the Idoteidae,[8] I stated that in *Synischia* and *Crabyzos* the coxal plates are coalesced with the peraeon segments. The fusion of the coxae with the body, however, is not more marked in *Crabyzos* than in many other species, but these joints are not expanded into conspicuous coxal plates. Each forms a socket into which the basis articulates and those of the second to seventh legs are slightly overridden by the feebly developed pleura of the thoracic segments, leaving a distinct suture. Suture lines between the coxae and the pleura have disappeared in *Synischia,* etc., owing to fusion; but this is not the condition in *Crabyzos,* excepting, as usual, on the first segment. The coxae of *Euidotea caeruleotincta* are much as in *Crabyzos longicaudatus;* in the last-named, however, the pleura are bent down so that the coxae are not visible in dorsal view.

Crabyzos longicaudatus, Spence Bate.

Bay of Shoals (Hale and Tindale).

The species was taken on the same weed as the preceding form; all specimens seen here were, as usual, uniformly graminaceous, but recently some examples with pale cross bands were dredged in Gulf St. Vincent.

Paridotea ungulata (Pallas).

Beare's Point (Hale and Tindale).

These specimens, which were taken on *Ulva,* were graminaceous in colour.

---

(8) Hale, Trans. Roy. Soc. S. Austr., xlviii., 1924, p. 214.

Pentidotea australis, Hale.

Pentidotea australis, Hale, Trans. Roy. Soc. S. Austr., xlviii., 1924, p. 220, fig. 8.

The holotype, a male, was taken on the shores of Kangaroo Island. As this example lacks the greater part of the second antennae, I take the opportunity of describing a female collected this year in Portland, Victoria, by Mr. H. W. Davey. This female has well-developed young in the brood-pouch. The body is wider than in the male, four and one-half times as long as greatest width, and is widest at the third and fourth peraeon segments. The whole upper surface of the body is covered with almost confluent brown dots; the legs and the underside are marked with distinctly separated brown spots. The second antennae of the right side is abnormal; the flagellum of the left antenna is short and consists of fourteen articles and a terminal style. Other characters are as in the example previously recorded. The juveniles in the marsupium are approximately 5 mm. in length. They have the head wider than the thorax, and the eyes relatively

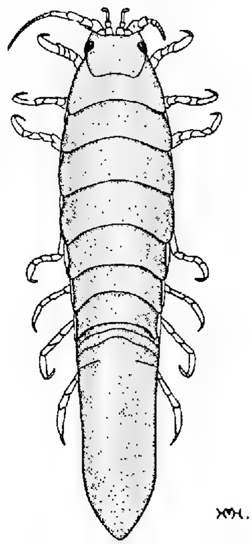


Fig. 5.
Pentidotea australis, adult female (x 1¼).

larger and more protuberant than in the adult. The flagellum of the second antennae consists of two articles and a minute terminal style. Length of female, 50 mm.

Family SPHAEROMIDAE.

Exosphaeroma bicolor, Baker.

Exosphaeroma bicolor, Baker, Trans. Roy. Soc. S. Austr., l., 1926, p. 249, pl. li., figs. 8-10, and pl. lii., figs. 1-5.

Bay of Shoals (type loc., Hale and Tindale).

The holotype and a number of paratypes were collected off Reeves' Point in shallow water, most of the specimens being taken in places where the bottom consists of broken shell. When crawling over, or resting on, *débris* of this sort, the animals were difficult to detect owing to their protective colouration. The legs and underside were white, but the upper surface was variable in colour; seven colour varieties were noted in the series secured. During life the dorsum of these was (a) uniformly greyish-black; (b) brown, with a white stripe on

each lateral margin of thorax; (c) greyish-blue, broadly margined with white and with a yellow stripe on whole length of mid-line of body, interrupted for a short space at first third of pleon; (d) uniformly pale grey; (e) white, with large brown mottlings on mid-line of thorax and at base of pleon; (f) white, more or less densely covered with fine brown mottlings excepting on margins; (g) uniformly white.

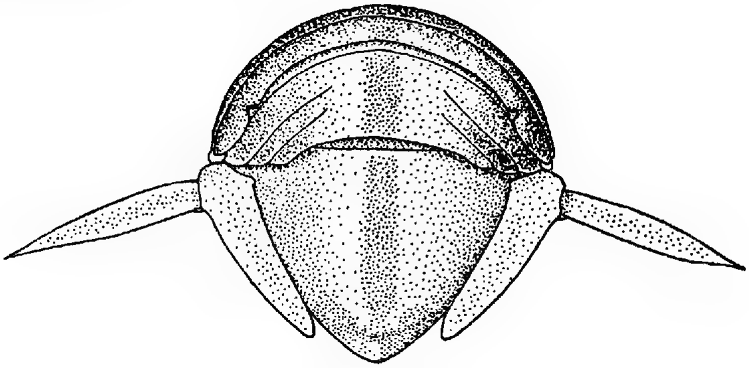


Fig. 6.
Exosphaeroma bicolor, attitude when alarmed (x 9).

The animal rolls into a sphere when disturbed, with the exopods of the uropods directed outwards (fig. 6).

ZUZARA VENOSA (Stebbing).

Bay of Shoals, very common under stones, etc. (Hale and Tindale).

CYMODOCE LONGICAUDATA, Baker.

Bay of Shoals, in shallow water (Hale and Tindale).

This species was so plentiful in parts of the Bay that we were able to fill a quart bottle with specimens after half an hour of hand dredging amongst *Zostera*.

PARACILICAEA HAMATA (Baker).

Vivonne Bay, 3 fath. (Hale and Tindale).

AMPHOROIDELLA ELLIPTICA, Baker.

Beare's Point, shallow water, on surface of living sponges (Hale and Tindale).

The creatures moved over the surface of the sponges with a rather slow, gliding motion, and greatly resembled small chitons. They were translucent during life, with faint fleckings and mottlings, or were uniformly whitish.

CERCEIS ACUTICAUDATA, Haswell.

Bay of Shoals, 0-1 fath. (Hale and Tindale).

Common amongst *Posidonia* in the Bay. The species is dark olivaceous or dark green during life, with head, sides of thorax, two ill-defined bars on thorax and one on pleon, mottled and spotted with white. When taken out of water and placed on a firm surface the animal is able to spring actively; this is accomplished by suddenly snapping the pleopods away from the pleon, the action producing a

faint "click." It swims extremely rapidly, but crawls slowly on shore; when placed on the beach it sometimes progresses in a series of short leaps (with the aid of the pleopods as described) or springs smartly back into the water.

ONISCOIDEA.

A new Scyphacid, which occurs commonly on sandy beaches of southern Australia, was taken by Mr. Tindale and myself on the shores of the island; Dr. Chilton examined specimens of this species some years ago, and intends to describe it.

On the island are numerous inland and coastal lakes, some of which contain permanent brackish or salt water; in some cases the water is derived directly from the sea, in others it is not. From all accounts these lakes are very similar to those of the mainland—weed and the mollusc *Coxiella* are present and so on—but, unfortunately, we had no opportunity of visiting any of them. A search of these waters may result in the capture of the interesting aquatic Oniscid *Haloniscus searlei*.(9) This species, which was first taken in a salt lake in Victoria, is common in the very salt water of the Pool of Siloam at Beachport, and residents of the south-eastern districts state that they have seen similar creatures in other salt lakes. The Beachport specimens were recently described under the name *Philoscia salina*, by Mr. Baker,(10) the Victorian record being overlooked.

Family ONISCIDAE.

Porcellio laevis, Latreille.

Kangaroo Island, no definite locality (W. H. Baker).

Porcellionides pruniosus (Brandt).

Kangaroo Island, no definite locality (W. H. Baker).

Family ARMADILLIDIDAE.

Cubaris ambitiosus, Budde-Lund.

Kangaroo Island, no definite locality (W. H. Baker); Kelly Hill, at mouth of caves (Hale and Tindale).

Family SCYPHACIDAE.

Deto marina (Chilton).

Shores of Kangaroo Island (W. H. Baker).

Family LIGIIDAE.

Ligia australiensis, Dana.

Vivonne Bay, in cave and on beach (Hale and Tindale).

A male from the above locality is figured. In this the second antennae are distinctly longer than the whole body, exclusive of the uropods; the proportions of the last three joints of the peduncle are 16:41:56, and the slender flagellum consists of twenty-six elongate articles. The first two pairs of legs are imperfectly subchelate, and there is no process on the propodus of any of the anterior limbs. The posterior margin of the telson is triangulate; the postero-lateral processes are

---

(9) Chilton, Proc. Linn. Soc. N.S. Wales, xliv., 1919, p. 724, figs. 1-20.

(10) Baker, Rec. S. Austr. Mus., iii., 1926, p. 145, fig. 77.

short and acute, and the accessory processes are well marked, subtriangular in shape. Length, 12 mm.

The *Ligia* here referred to Dana's species is common at Vivonne Bay. A great many individuals were uncovered when boulders were overturned in a cave in the cliff; when disturbed the Isopods scattered in all directions and quickly

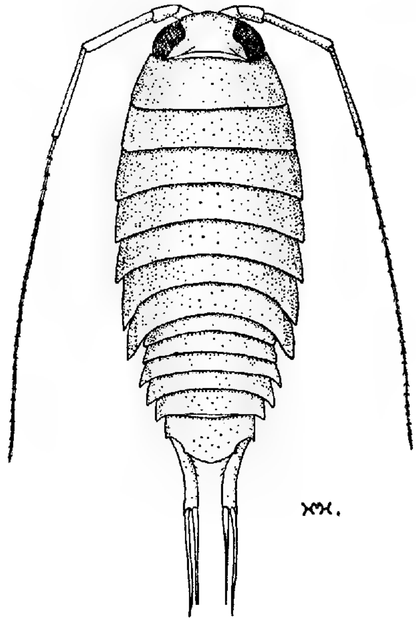


Fig. 7.
Ligia australiensis, adult male (x 5).

disappeared under the neighbouring stones and *débris*. Towards sunset and during the evening hundreds of examples were noticed on rocks near the sea and on the sandy beach, but few specimens were seen in these places during the day.

Order MYSIDACEA.

Family MYSIDAE.

Australomysis incisa, Sars.

Vivonne Bay, 3-3½ fath. (Hale and Tindale).

Siriella (?) australis, Tattersall.

Bay of Shoals, ½ fath. (Hale and Tindale).

Order CIRRIPEDIA.

Lepas anserifera, Linnaeus.

Vivonne Bay, on beach (Hale and Tindale).

Lepas hillii (Leach).

Vivonne Bay, on beach (Hale and Tindale).

Ibla quadrivalvis (Cuvier).

Bay of Shoals, moderately common in shallow water (Hale and Tindale).

THE FAUNA OF KANGAROO ISLAND, SOUTH AUSTRALIA.

(Under the aegis of the Fauna and Flora Board.)

No. 2.—THE MAMMALS.(1)

By Edgar R. Waite, F.L.S., and Frederic Wood Jones, D.Sc., F.R.S.
(Contribution from the South Australian Museum.)

[Read October 13, 1927.]

[The following notes are, in part, compiled from memoranda by Prof. Wood Jones, left with the Board on his transference to Honolulu. As, however, the notes were not in form for publication, and have been added to, joint authorship is indicated; the responsibility for errors to be assigned to E.R.W.]

ORNITHODELPHIA.

ECHIDNIDAE.

Echidna aculeata, Shaw, 1792. Native Porcupine.

The island form is characterised by its small size, fine spines and pale colouration, and is referable to the subspecies *E. a. multiaculeata*, Rothschild. It is common in certain parts of the island and plentiful on the reserve. It pairs early in August, and Mr. Burgess says that it is not uncommon to see several males following a female. On several occasions porcupines have been seen by members of the Board moving around in broad daylight.

DIDELPHIA.

DASYURIDAE.

Dasyurus viverrinus, Shaw, 1800. Native Cat.

This is apparently the only carnivorous mammal that existed on the island, from which it now seems to have disappeared. Some of the older inhabitants remember having seen a few individuals many years ago, and a single mandible was found in a bone hole at Cape de Couëdic, during the visit of the Board in November, 1923.

PERAMELIDAE.

Isoodon obesulus, Shaw, 1797. Short-nosed Bandicoot.

Though disappearing from the mainland, this animal still maintains a footing in the sanctuary of Flinders Chase, the only indigenous enemy being the large goana *(Varanus)* which is common on the island. The bandicoot is no mean adversary and may not, in consequence, be molested by feral cats.

PHALANGERIDAE.

Pseudochirus laniginosus, Gould, 1858. Ring-tailed Opossum.

The South Australian animal, distinguished under the name *P. l. notilis*, Thomas, 1923, though fairly common in suitable districts on the mainland, does not appear to have reached the island in the ordinary course. On October 1, 1926, fifteen specimens, of which four were males, were liberated near the

(1) See also Handbook to the Mammals of South Australia, Wood Jones, 1923-1925.

homestead, but it is too early yet to ascertain how they may have fared. They were obtained from Mount Pleasant, in this State.

Phascolarctus cinereus, Goldfuss, 1819. Native Bear.

At no recent period does the native bear or koala appear to have got into South Australia beyond a small area fringing the Victorian border, and it is doubtful if it could be found within our province to-day. On the remote chance of acclimatising the species on Kangaroo Island a number of animals of both sexes, together with mothers and young, were taken from Victoria and liberated on Flinders Chase in November, 1923. One or two specimens have been since reported as seen by the ranger, at a considerable distance from the point of liberation, and the best is therefore hoped for.

Dromicia concinna, Gould, 1841. Dormouse Opossum.

This little animal appears to be distributed all over the island, including Flinders Chase, where it enjoys such protection as it is possible to afford. The main danger with which it is threatened arises from the devastating effects of bush fires, for it does not burrow, but lives in holes of trees and frequents the tops of "black boys" *(Xanthorrhoea)*.

Trichosurus vulpecula, Kerr, 1792. Opossum.

The island form differs from typical examples in its larger size, long fur, and tawny colouration. It exactly resembles the grey Tasmanian opossum and is very abundant, the judicious trapping on the reserve in no wise lessening its numbers. It makes regular runways from tree to tree in which the snares are set, but it also often springs the larger traps set for wallabies.

MACROPODIDAE.

Betongia lesueuri, Quoy et Gaimard, 1824. Rat Kangaroo.

Specimens bred and reared in captivity in Adelaide were liberated within the observation enclosure on the reserve and seem to be doing well. If, when they are turned out into the larger world, they can avoid the goana *(Varanus)* they should prosper.

Macropus (Thylogale) eugenii, Desmarest, 1817. Wallaby.

The animal identified under this name is abundant on the island and, enjoying the protection afforded by the reserve, its survival seems to be assured.

Macropus fuliginosus, Desmarest, 1817. Kangaroo.

This fine animal is widely, if thinly, spread over the island; but on the Chase, where it is rigorously protected, it is quite common, and, in the early mornings, numbers may be seen feeding on the flats in front of the homestead.

PHASCOLOMYIDAE.

Phascolomys (Lasiorhinus) latifrons, Owen, 1845. Hairy nosed Wombat.

Being in grave danger of extermination, and having a distribution restricted to South Australia, it is the intention of the Board to attempt to acclimatise the wombat on Kangaroo Island; the sending of a single specimen to the Chase on

October 1, 1926, may therefore be recorded; others will be forwarded as soon as obtained.

MONODELPHIA.

CETACEA.

So few reliable identifications of the whales and dolphins that have occurred in the waters immediately surrounding the island have been made, that the following list is naturally incomplete. At one period whaling was extensively prosecuted, mainly by Americans, who have left behind certain relics of their temporary occupation.

BALAENA AUSTRALIS, Desmoulins, 1822. Right Whale.

Represented by portions of skulls, vertebrae, and ribs still sticking in the coastal beaches or adorning the gardens of the inhabitants.

NEOBALAENA MARGINATA, Gray, 1866. Pigmy Right Whale.

Two individuals were obtained at Kangaroo Island, apparently in 1889. A third specimen was represented by an ear bone.

BALAENOPTERA MUSCULUS, Linnaeus, 1758. Blue Whale.

The occasional reports of large whales seen off the island doubtless refer to this animal, of which a number, young and old, visit our waters.

PHYSETER MACROCEPHALUS, Linnaeus, 1758. Sperm Whale.

Teeth and vertebrae are preserved in the homes of settlers on the island, but no recent occurrences of the whale appear to have been reported.

DELPHINUS DELPHIS, Linnaeus, 1758. Dolphin.

Very common all around the island and in our waters generally.

RODENTIA.

MURIDAE.

RATTUS GREYI, Gray, 1841. Native Rat.

This is probably the only native rat now living on Kangaroo Island, where, however, it is rare, having the goana *(Varanus)* and feral cats as enemies of itself and young. Specimens have been obtained recently at Rocky River and D'Estree Bay.

PINNIPEDIA.

OTARIIDAE.

ARCTOCEPHALUS CINEREUS, Peron, 1816. Hair Seal.

This is the larger seal of the island, the dark coloured pups being frequently mistaken for adults of the smaller fur seal.

ARCTOCEPHALUS DORIFERUS, Wood Jones, 1925. Fur Seal.

It is believed that a few examples still visit the inner Casuarina Island, which is now a proclaimed sanctuary, and is in view from the lighthouse at Cape de Couëdic.

PHOCIDAE.

HYDRURGA LEPTONYX, de Blainville, 1820. Leopard Seal.

This southern seal has been twice reported from the island, and several occurrences from the shores of the mainland are known.

CHIROPTERA.

NYCTOPHILUS GEOFFROYI, Leach, 1822. Long-eared Bat.

The bats of the island have not yet received much attention. This species is very common.

INTRODUCED ALIENS.

Horses, cattle, sheep, goats, and dogs, introduced in the ordinary course of human settlement are all under control, but it is different with pigs and cats. Though not troublesome in settled areas, the wild and wide expanses of the western end of the island afford cover and immunity to numbers of feral swine, which root up acres of ground, including the flats around the homestead. Though descended from domestic stock, the pigs have reacquired their racial characteristics and are as wary of man as any truly wild swine. All those seen are black, and several have fallen victims to rifle fire. Feral cats are numerous and a menace to the native birds. Rabbits were placed on the island many years ago, but fortunately failed to maintain a permanent footing, and it is unlikely that there is a single example on Kangaroo Island to-day. The brown rat, the ship rat, and the house mouse are as common on the island as elsewhere in Australia.

THE FAUNA OF KANGAROO ISLAND, SOUTH AUSTRALIA.

(Under the aegis of the Fauna and Flora Board.)

No. 3.—THE REPTILES AND AMPHIBIANS.

By Edgar R. Waite, F.L.S., C.M.Z.S.,
Member of the Board and Director, South Australian Museum.

(Contribution from the South Australian Museum.)

[Read October 13, 1927.]

This list, with a few notes on some of the species, is mainly extracted from the manuscript of the "Handbook on the Reptiles and Amphibians of South Australia," now in course of preparation as one of the series issued by the British Science Guild (S.A. Branch).

CHELONIA.

Dermochelys coriacea, Linnaeus, 1766. Luth.

The leathery turtle has been seen several times in Investigator Strait, the waters of which wash the northern shores of the island, and examples are preserved in the Museum.

Caretta caretta, Linnaeus, 1758. Loggerhead.

Turtles are sometimes reported as having been seen in the Strait, and Sir Joseph Verco, who at one time did much dredging in the two Gulfs, tells me that he occasionally saw what he presumed to be green turtles. The only turtle from our waters that I have had the opportunity of examining proved to be a Loggerhead.

LACERTILIA.

GEKKONIDAE.

Gymnodactylus miliusii, Bory St. Vincent, ? 1825. Thick-tailed Gecko.

Fairly common under stones and beneath the bark of trees, whence it issues at night in search of food.

Phyllodactylus marmoratus, Gray, 1845. Marbled Gecko.

Though found on the ground beneath boulders and logs, it is more frequently seen beneath the loose bark of trees. If gently thrown against the trunk of a tree, it just sticks there, the claws immediately taking hold of the rough bark.

Peropus variegatus, Dumeril et Bibron, 1836. Dtella.

Normally found under logs and beneath the bark of trees, this little gecko invades houses and, in common with other members of the family, generally sheds its tail when handled or when receiving a shock, though not necessarily touched.

PYGOPODIDAE.

Pseudodelma impar, Fischer, 1882. Snake Lizard.

This, the only member of the family identified from the island, is not at all uncommon around the homestead at Rocky River. On lifting a log or stone it

may sometimes be found coiled up and apparently asleep; it may thus remain for a second or two, when, evidently realising the advent of daylight into its retreat, it rapidly seeks new cover. With the exception of a new genus and species added since the date of its publication, all our members of the family were illustrated in the Prodromus issued by Sir Frederick McCoy,[1] but owing to a series of unfortunate errors, the text references to some of the plates is very misleading and would seriously bewilder a novice. The following references and corrections may therefore be noted:—

Pygopus lepidopodus (lepidopus), pl. 152 and 153, fig. 2.
Delma fraseri (frazeri), pl. 153, fig. 1.
Pseudodelma impar, pl. 161, fig. 2.
Aprasia pulchella, pl. 161, fig. 1.
Lialis burtonii, pl. 162, figs. 1 and 2.

In writing his Catalogue of Australian Lizards, F. R. Zietz [2] unfortunately failed to detect the errors and altogether missed McCoy's reference to *Pygopus lepidopodus*, which genus and species were omitted as occurring in South Australia.

AGAMIDAE.

AMPHIBOLURUS DECRESII, Dumeril et Bibron, 1837. Tawny Dragon.

This lizard, with which the French name of the island, "L'ile de Decrès," is associated, has been taken on granite boulders at the mouth of the Rocky River, but does not appear to be common on the island; it is not known outside the limits of South Australia.

TYMPANOCRYPTIS LINEATA, Peters, 1863. Earless Dragon.

The reference published in the Catalogue of the British Museum [3] appears to be the only record of the species on the island.

VARANIDAE.

VARANUS VARIUS, Shaw, 1790. Goana.

Of the five species of the genus recorded as occurring in South Australia, this is the only one found on Kangaroo Island. It may be said to be the only indigenous carnivorous animal on the island, and full-grown opossums have been taken from the stomachs of the reptiles.

SCINCIDAE.

EGERNIA WHITII, Lacepede, 1804. White's Skink.

The commonest and most widely distributed species of the genus, being found all over Australia and Tasmania. It occurs on Franklin and Greenly Islands, in the Australian Bight, and is common on Kangaroo Island; the insular forms generally lack the striking markings of some of the mainland individuals.

TRACHYSAURUS RUGOSUS, Gray, 1827. Shingle-back.

Though so common on the mainland, this peculiar lizard is not indigenous to Kangaroo Island. About 100 examples were placed on Flinders Chase, on the western end of the island, in 1926, by the Fauna and Flora Board of South Australia.

(1) McCoy, Prod. Zool. Vict.

(2) Zietz, Rec. S.A. Mus., i., 1920, pp. 181-228.

(3) Boulenger, Cat. Lizards, Brit. Mus., i., 1885, p. 392.

HINULIA QUOYI, Dumeril et Bibron, 1839. Water Lizard.

Though the vernacular name is more properly applied to members of the agamoid genus *Physignathus*, it is locally used for the skink on account of its predilection for water, into which it plunges when alarmed. Dr. Chisholm has fed this lizard on flies, which it took from the end of a pointed stick to the number of fifty within about half an hour.

LEIOLOPISMA METALLICUM, O'Shaughnessy, 1874. Metallic Skink.

This little lizard is common on the island, where it inhabits open rock-strewn country. The spelling of the subgeneric name is according to the original form.

HEMIERGIS PERONII, Fitzinger, 1826. Four-toed Skink.

Two species bear the name *Lygosoma peronii* in the Britsh Museum Catalogue; the one from Queensland described by Dumeril et Bibron becomes *L. blackmanni*, De Vis. The southern lizard is common on the mainland and occurs on many of our islands, including the South Neptunes, St. Francis, Pearson, Price, and Flinders Islands in the Australian Bight. On Kangaroo Island it is scarcely possible to move more than a couple of logs without disturbing one of these lizards. On the accession of daylight an individual may wriggle snake-like down a hole or into the surrounding herbage.

HEMIERGIS DECRESIENSIS, Fitzinger, 1826. Three-toed Skink.

This species occurs throughout southern Australia and is found sparingly on Kangaroo Island and on Flinders Island, in Nuyts Archipelago.

RHODONA BOUGAINVILLII, Gray, 1839. Bougainville's Skink.

In Victoria it is said to be found under logs and stones in moist places. On Kangaroo Island it occurs among the herbage of the sandhills.

ABLEPHARUS LINEO-OCELLATUS, Dumeril et Bibron, 1839. Garden Skink.

Common on the mainland, this snake-eyed lizard has also been taken on St. Francis Island. Specimens from Kangaroo Island have been identified with the variety *A. anomalus*, Gray.

OPHIDIA.

NOTECHIS SCUTATUS, Peters, 1861. Tiger Snake.

This is the only snake known from the island, where, however, it is common. The species is very prone to melanism, and the majority of the individuals taken on Kangaroo Island exhibit this phase, which has been accorded varietal rank by Mr. Kinghorn, under the name *N. s. niger*. The tiger snake is an extremely variable species as far as colouration is concerned, and every shade of colour and marking may be met with, from pale yellow to yellowish-red with conspicuous bands, to grey, and finally to black, in which the bands are lost in the general depth of colour.

AMPHIBIA.

CERATOPHRIIDAE.

The generally accepted name of the family is Cystignathidae, but as there appears to be no valid name to support it, the oldest, namely, *Ceratophrys*, Boie, 1824, is here adopted.

LIMNODYNASTES TASMANIENSIS, Günther, 1858. Marbled Frog.

This widely-distributed species is not uncommon on the island and is found under stones in damp places, resorting to the water for breeding purposes.

LIMNODYNASTES DORSALIS, Gray, 1841. Swamp Frog.

Excepting during the prolonged breeding season the Swamp Frog is seldom seen, for it burrows and remains underground during the day. A short note on some habits of the frog on Kangaroo Island has been previously published.[4] The vomerine teeth are generally disposed in two groups, one on each side of the choanae. They may coalesce into a single series, but there is usually indication of the two components. The teeth are very numerous and have double curved tips.

CRINIA SIGNIFERA, Girard, 1853. Brown Froglet.

This, the smallest of our amphibians, is as common on Kangaroo Island as elsewhere, and, during dry weather, hides under stones and logs, attempting to escape by leaping. After the first heavy rains it makes for the pools and sets about breeding, even in winter. Vomerine teeth are not developed in this species.

BUFONIDAE.

PSEUDOPHRYNE BIBRONII, Günther, 1858. Toadlet.

As with *Crinia, Pseudophryne* has no vomerine teeth and no visible tympanum, but may be distinguished by its larger size and its apparent indisposition, or inability, to jump. It is common on the island and is found under cover of logs and stones squatting in a little "form" to which it apparently returns after its nocturnal peregrinations in search of food. It does not resort to water even for breeding purposes.

HYLIDAE.

HYLA EWINGII, Dumeril et Bibron, 1841. Tree Frog.

The only member of the family found on Kangaroo Island, where it is common in the rank vegetation. The vomerine teeth are few in number and simple in form. The eggs of this frog do not float but are attached to submerged weeds in small bunches which encircle the stems of the plants, and may be found at almost any time of the year.

---

(4) Waite, Rec. S. Austr. Mus., iii., 1925, p. 31.

THE STURTIAN TILLITE IN THE NEIGHBOURHOOD OF EDEN, AND IN THE HUNDREDS OF KAPUNDA, NEALES, AND ENGLISH, SOUTH AUSTRALIA.

By Professor Walter Howchin, F.G.S.

[Read October 13, 1927.]

Plates XIV. and XV.

The tillite, which is typically developed in the valley of the River Sturt, is one of the most distinctive horizons in the Adelaide Series. From its persistent and uniform characteristics throughout the range of its occurrence it supplies a most useful criterion in the determination of the order of succession in many geological sections.

The geographical range of the beds is essentially that of the Adelaide Series, maintaining, throughout, the same relative position in the series in relation to the associated beds. It follows the general strike of the series, as a whole, in a north and south direction, with transverse foldings in successive anticlinal and synclinal folds. The anticlinal curves have been mostly removed by denudation, with the result that the tillite becomes exposed through the truncation of the synclinal margins. There is usually a strong quartzite underlying the tillite, which, from its superior resistance to weathering, makes prominent ridges in parallel ranges, and is often suggestive of the presence of the tillite on its less exposed face. In accordance with the "grain" of the country the tillite is repeated, on an east and west line, in distances a few miles apart according to the acuteness, or otherwise, of the tectonic curves.

As to the geological age of the Sturtian Tillite, in the first instance it was regarded (together with the group of beds classed together as the Adelaide Series) as of Lower Cambrian age. One or two American geologists (partly on the grounds that the Lower Cambrian fauna of North America appeared to indicate somewhat warm conditions; as well as from the fact, that a few years subsequently to the South Australian discovery a glacial deposit was announced from the Pre-Cambrian of Canada) were disposed to correlate, as to age, the South Australian tillite with the Pre-Cambrian tillite of Canada. In the present volume of the Society's Transactions there are two contributions [by T. W. E. David and J. W. Gregory] which appear to favour the Lower Cambrian age of the South Australian beds, as was at first suggested.

In the following notes opportunity is taken to include brief descriptions of local geological features more or less connected with the glacial beds. The paper consists of the transcription of Field Notes, which, in most cases, were limited to single short visits to the localities; they are therefore of the nature of reconnaissances only. It will be convenient to refer to the Sturtian Tillite as the older tillite to distinguish it from the Permo-Carboniferous glacial beds which are of much later date.

Localities.

THE TILLITE AT EDEN.

Eden is situated on the Adelaide to Melbourne railway, a little less than nine miles to the southward of Adelaide. The tillite in this locality is continuous with that in the Sturt valley, forming, roughly, a square-shaped area, the approximate boundaries of which are defined by the Viaduct Gully, on the north side; the River Sturt, on the South; Bedford Park, on the west; and along a line drawn from Eden, via the Blackwood Metropolitan Brickworks, on the railway, southwards, to the River Sturt, on the east. The area thus occupied by the glacial beds measures two miles in a north and south direction, and a mile and three-quarters in an east and west direction. Eden takes in the north-eastern angle of this area, including the Viaduct Gully (fig. 1).

Taken as a whole, the beds occupy an isolated position and may be regarded as block-faulted. The glacial beds are seen with their topmost beds exposed on their western boundary, and their basal beds, on their eastern boundary; showing a tilt of the block, by an upcast on the eastern side, where they are over-ridden by the subglacial beds in a thrust from the east.

EDEN RAILWAY STATION AND NEIGHBOURHOOD.

The railway station at Eden is situated in a cutting in the tillite. The rock as seen in the cutting is a fine-grained, light-coloured ochreous slate, partially decomposed and, mostly, free from grit, but carries an occasional erratic. On the up-platform of the station, northward of the shelter shed, and near the first electric light rod, a quartzite erratic occurs in the tillite, 9 inches in length; and just past the second light is a subangular erratic of gneiss, 4 feet in length, by 1 foot 8 inches, in cross section. Near the end of the cutting in which the station is situated, going north, a marked change in the form of the tillite is seen in outcrop over the fence, on the eastern side of the line. Here the glacial bed is very coarse and stony.

About 100 yards of low ground separate the first cutting from a second one, which is also in tillite of similar type to that in the first. It is also seen on a road (formerly a "runaway" siding) which goes up from the main track on the eastern side. The end of this road, as also the associated cutting, marks the end of the glacial beds at their north-eastern limits. There follows a short stretch of low ground in which slate rocks are much crushed and disturbed, marking the zone of contact between the tillite and the subglacial compact slates and thin quartzites which occur in the adjoining (No. 3) cutting. These underlying beds exhibit wavy contortions, as well as "herring-bone" structure, in some places, similar to what occurs at the base of the tillite in the railway cutting near the Blackwood Brickworks (see Howchin, Geol. of S. Austr., 1918, p. 347, fig. 270).

The tillite, from its north-eastern angle, near Eden, has its eastern limits almost parallel with the railway on its eastern side, varying from a chain to two chains in width (probably more in places). At the Metropolitan Brickworks it crosses the railway and continues through scrub country in a southerly direction to the River Sturt, where it is overthrusted and thrown out at the south-eastern angle of the faulted block. From this point it follows the left bank of the Sturt to its second crossing of the river in Section 81, as described below.

Throughout the central portion of the tillite block, there are numerous outcrops. At the Eden Station, in a small gully situated almost immediately behind the shelter shed on the up-platform, the beds make a small waterfall by a vertical face of rock. A still better section of this kind can be seen, a little south of the station, by following the railway line, under an overway bridge, and passing through a fence, on the right-hand side, and following the road for about 200 yards, a waterfall is seen on the right hand with a sheer face of about 20 feet, containing many erratics (pl. xiv.). The tillite can also be seen in most of the small

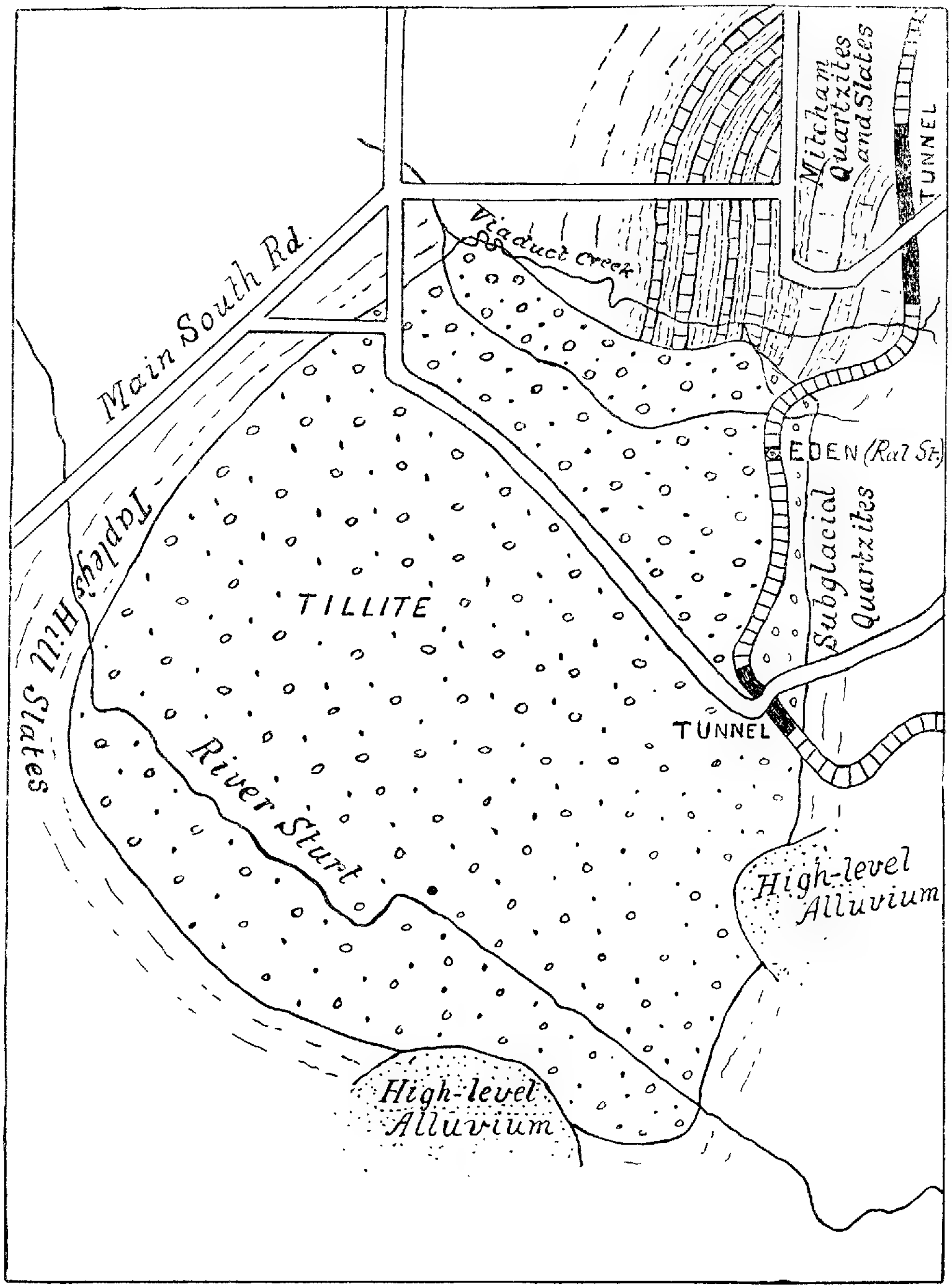


Fig. 1.
Locality Plan of Tillite at Eden and River Sturt.

creeks that drain towards the Sturt, especially in the Blackwood Creek, where at its junction with the Sturt many fine faces of the tillite are exposed both in the creek itself and in the banks of the river.

VIADUCT GULLY.

(Observations made April 2, 1904.)

The Viaduct Creek takes its name from the railway viaduct which formerly spanned the valley. The creek takes its rise on the Belair-Blackwood "shelf," and, after passing under the railway, flows north-westerly, intersecting the South Road a little to the northward of the Lady MacDonnell Hotel.

Beds Beneath the Tillite.

Interesting sections of the beds inferior to the tillite can be seen in the upper portions of the creek. Starting from Blackwood Railway Station the creek was entered about a half-mile above the viaduct. The stone here, is an arenaceous slate (or shale). The bedding is somewhat obscure from the fact that the stone has a grain in two directions. One, which probably indicates the true bedding plane, has a dip E. 20° S. at 30°. The bed is finely laminated and shows fine lines with irregular wavy texture. The other direction of the grain has also a wavy texture and weathers into bands, with a dip W. at 70°. In places it assumes the features of cone-in-cone structure. The divergence mentioned probably arises from tectonic distortions. A little lower down the creek the dip is W. 20° S. at 20°.

Shortly before reaching the present railway line [1] there is a remarkable contortion of the subglacial beds seen in a precipitous cliff, about 100 feet in height, on the southern side of the valley. The section (fig. 2) includes two pitching

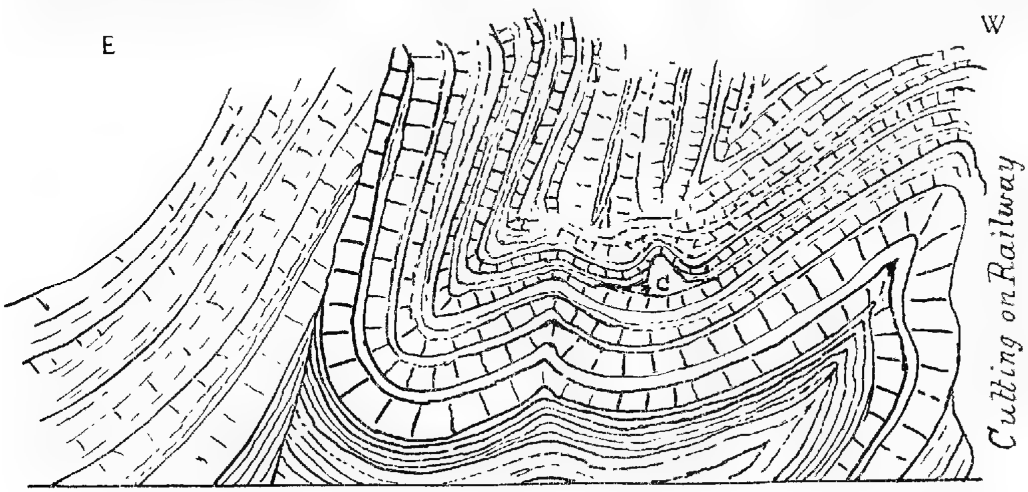


Fig. 2.

Distortion and overthrusts of subglacial beds on the eastern side of the railway. C marks the position of cave caused by a tectonic fold.

anticlines caused by a thrust from the east. The more easterly of the two is a broken anticline having slipped along the main axis of the overfold, while the westerly example rises at an angle of about 60° and has its return limb (also an overfold) exposed in the first important cutting on the railway to the southward

(1) This and the following paragraphs have been slightly modified from the original notes to bring the descriptions into accordance with the later deviation of the railway from the original tunnel and viaduct that were situated a little lower down the valley.

of the tunnel. In the synclinal trough between the two anticlines the beds, through lateral pressure, have been puckered up into minor folds. One of these shows an anticlinal curve rising from a synclinal base, with its central portion fallen away so as to form a shallow cave, about 6 feet in height, in the line of axis, as shown in fig. 2 (marked C). This feature also occurs with other folds in the neighbourhood.

On the opposite bank of the creek, close to the railway, is another interesting anticline, well seen in section. When the line was in course of construction the western limb of this anticline formed the side of a cutting and, being a weak structure, came away one night, and, according to the foreman of works, deposited 12,000 tons of stone on the rails at the entrance to the tunnel. [Illustrates the importance of geological knowledge in railway construction.]

In the cuttings on the railway following that shown in fig. 2 the subglacial beds can be further studied. The beds, as is usual to this horizon, are greatly disturbed by being thrown into a vertical position, or with a slight westerly dip, with numerous small contortions, and before reaching the point where the former viaduct ended, the dip becomes E 20° S.

Again, on the same side of the valley, but on the western side of the railway, near the embankment where the railway makes a sharp turn to the southward, another double overfold occurs in the thin quartzites of the subglacial beds (fig. 3).

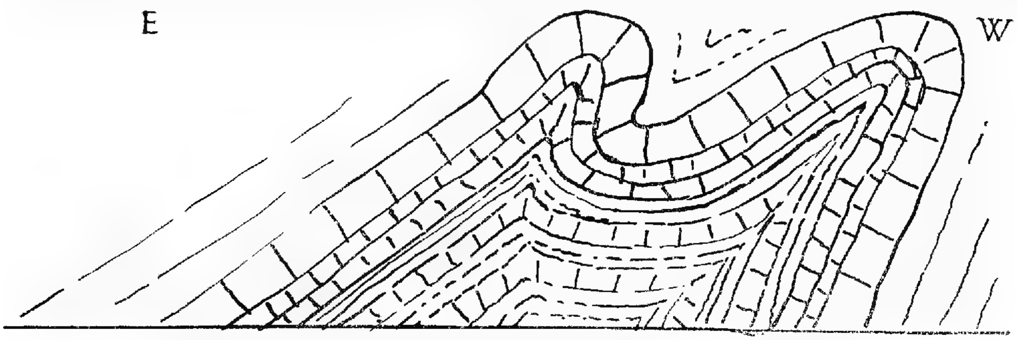


Fig. 3.
Overfolds in the subglacial beds on the western side of the railway.

In some of the sharp folds in this locality the core of the bend has dropped out, leaving a cavity or cave. The scarp face showing this section could formerly be well seen from the southern end of the now obsolete railway tunnel, across the valley, but is now hid from view by the tips thrown over during the alterations to the permanent way. The downthrow of the tillite block formed a strong foreland against which the thrust wave from the east became broken.

The Tillite.

The position shown in figs. 2 and 3 brings us close to the north-eastern angle of the tillite faulted block. From this point, following the left bank of the creek, the tillite is seen in a series of lumpy and serrated exposures along the rise and determined by a north-westerly fault that cuts off the beds on their northern side.

From the railway, where the tillite comes to an end, as described above, the boundaries of the glacial beds can be easily followed in a westerly direction. On the inner side of the iron fence, bordering the railway on its western side, is a granite boulder measuring 2 feet 9 inches, by 1 foot 9 inches, with smaller boulders scattered around. The line of outcrop slopes down to near the bottom of the valley in a line with a small lateral creek that comes down from the railway, and in which an excellent face of tillite can be seen.

The unconformity of the tillite to the older beds is here a conspicuous feature. The Mitcham quartzites and slates, which coming from Sleep's Hill quarries, strike south-westerly through Ayliffe's old quarries and, either by a curve in the strike, or by subsidiary faulting, meet the tillite in the Viaduct valley at right angles. These Mitcham beds, although at a lower horizon than the subglacial thin quartzites, have been under the influence of the same thrust from the east, and in the old quarries, just referred to, are very strongly folded in rolling curves and anticlines which are at times very acute and sometimes broken by faults.

The fault plane separating the two sets of beds has a north-westerly trend and follows the left bank of the creek. The exact juncture of the two series cannot well be exactly defined, probably on account of the thrust wave from the east having overridden the tillite boundary. The tillite of the locality is coarsely but intimately laminated, as the result of cleavage planes, that have a strike S. 20° W., with an easterly dip at 65°. The strike of the cleavage is thus practically at right angles to the thrust, which is as it ought to be.

In the lower portion of the Viaduct valley creek the tillite comes down to the creek level at a point where two small horseshoe curves occur in the stream, within about 200 yards of the district road that strikes easterly from the main South Road at the Lady MacDonnell Hotel. From there it curves south-westerly, crossing at the angle of two district roads, as shown on the Locality Map (fig. 1), and heads for the River Sturt.

TILLITE AT SPRINGBANK.

(Observations made November, 1906.)

A narrow strip of the tillite can be seen in two places situated to the northward of the Viaduct valley, in a line from the north-western angle of the faulted-block and following a north-eastern strike towards the Goodwood road.

The first of these outcrops can be located by following the Goodwood road, southerly, for nearly a mile from the Springbank road to where a culvert crosses the road in the rise of the hill up to the northern banks of the Viaduct valley. In the creek, going westerly, are laminated and wavy quartzites with a dip E. 20° S. at 65°. Within 100 yards from the road the tillite is exposed, having a cleavage strike N. 20° E. at 70°. The tillite has a breadth of about 100 yards and is then obscured by the alluvium of the plains.(2) In a north and south tributary, a little to the south-westward of the position just referred to, laminated and wavy quartzites with slates are exposed, covered, in places, by a hard floor of Pleistocene alluvium. The quartzite can be followed up the creek to a series of quarries. The strike in the small tributary creek is N. to 15° E.

The second exposure of the tillite in this neighbourhood occurs at a distance of about half a mile from the one just described, in a south-westerly direction, and is close to the Waterworks reducing tank, in Section 13, at the head of the road that goes easterly from the Lady MacDonnell Hotel. The bed is seen in a small gutter that carries away the overflow from the tank just mentioned. The tillite can also be seen in a small washout that runs at right angles to the overflow gutter and can be traced up the hill for 50 yards. Quartzites can be observed on both sides of the tillite. It is evident that the latter has been brought to the surface by an, approximately, north and south downthrow fault that intercepts the east and west fault of the Viaduct valley at its western end, to which position the tillite can be almost traced. The latter seems to form the edge of the Burnside platform, with the fault scarp dipping to the westward beneath the alluvium.

(2) A recent visit to this locality has shown that the surface features are now entirely different from what they were in 1906. The land that was then open and unoccupied is now built upon and cultivated. The rocks seen in the creek, at that time, are now covered by the falling in of the alluvial banks; so that the geological section is not now available.

TARLEE AND ROSS' CREEK.

(Observations made on May 17, 1905, and later.)

Beds Beneath the Tillite.

On the western side of the railway at Tarlee, in creek, near the township, is a dark-grey sandstone. The beds are nearly horizontal and roll in low anticlinal curves. About a mile to the westward of the township are the Tarlee quarries. The stone, here, is similar to that seen in the creek just referred to. The bedding planes are strongly marked—some thin, others thick—which enables large blocks to be quarried in the bedding. The grain of the stone shows fine lamination, with a large proportion of a dark-coloured granular material, evenly distributed through the mass. The beds roll gently in periclinal curves in which both strike and dip are involved. The dip has a prevailing direction to E. or N.E. There occur, in places, some peroxide of iron, accompanied by a wavy structure. A number of small faults occur, but with only slight displacements. The beds are suggestive of the upper members of the thick (Black Hill) quartzite, as seen in the Morialta gorge above the first waterfall. On the eastern side of the quarries is an iron reef that has been worked—probably marks the presence of a fault.

On the eastward side of Tarlee the ground is only slightly elevated and is cultivated, with a subsoil resting on slates. On the east-west district road (Hd. of Gilbert), between Sections 326 and 275, there is an excavation on the road-side, exposing rotten slate having a dip E. 20° N. at 65°. At a distance of about two miles from Tarlee the ground begins to rise to the main ridge. At the foot of the range there are small exposures of a laminated shale, even with the ground; following which, in superior position, is a very siliceous quartzite.

In travelling from Adelaide by train, on the main north line, a definite feature on the eastern side is a range of hills which often shows picturesque outlines. This range is known by various local names at different points. Thus, opposite Riverton, it is known at Peters' Hill Range, and where crossed by the main road between Tarlee and Kapunda, it is called the Allandale Range. The range continues in a south-easterly direction, following the western side of Hawker's Creek, and then curves round to the River Light, which it crosses about two miles to the northward of Fords railway station, to be referred to later. The range consists mainly of quartzite and is of interest as it follows the outcrop of the older tillite, which it underlies.

The main road from Tarlee to Kapunda passes over this range at "The Gap," which reaches its culminating point at about four miles from Tarlee, and forms the boundary between the Hundred of Gilbert and Kapunda. The western portion of the range consists of a very siliceous quartzite, having the general characteristics of the Glen Osmond and Mitcham quartzite, with a thickness of about 20 yards. (Dip in quarry, N.E. at 50°.) The outcrop is strong, in places laminated, and will split into layers. It is a light-coloured stone, much riddled with quartz veins, which is a feature of the locality, some veins reaching 2 feet in thickness, with evidences of much dislocation of strata. The general strike of the country is N.N.W. and S.S.E., with an easterly dip, generally high.

Following on the quartzite, is a secondary ridge of very thick and massive phyllites, or slates, separated from the quartzite, described in the last paragraph, by a narrow valley of erosion. The slates contain bands that are calcareous, and others that are arenaceous. At the six-mile post from Kapunda (on the western side of the boundary of the Hundreds) there is a road-cutting in these slates that shows a strike N.N.W., and a dip of 65° easterly. Quartzites occur again on the eastern side of these slates. A remarkable isolated and pyramidal hill of quartzite, almost bare, but on which a few poor sheaoaks are growing, occurs on the southern side of the road in Sec. 123 (Hd. of Kapunda). A farm-

house is situated on its lower slopes to the eastward. It seems probable that the main quartzite represents the Mitcham quartzite, the succeeding slates, the Mitcham upper slates; and the following quartzite, the quartzite that underlies the tillite, which immediately follows in ascending order.

The Tillite.

After passing through "The Gap," the Kapunda enclosed forest and reservoir are on the northern side of the road; and, within a mile, a great exposure of the older tillite occurs by the side of the road, in the banks of Ross' Creek, and also in the adjoining paddocks. Ross' Creek is a tributary of the River Light. After supplying water to the Kapunda reservoir, it flows southwards, making a junction with the Light near where the Kapunda railway crosses the latter river.

On the north-eastern side of Ross' Creek there is a very extensive outcrop of the tillite, about a mile in length. It occurs in paddocks running parallel with the public road, passing through Sections 106, 89, and 90 (Hd. Kapunda). In the last-named Section the exposures are particularly massive and prominent (see pl. xv.). The bed seldom shows cleavage but outcrops in rounded, whale-back contours, often assuming irregular shapes but always very compact. The erratics

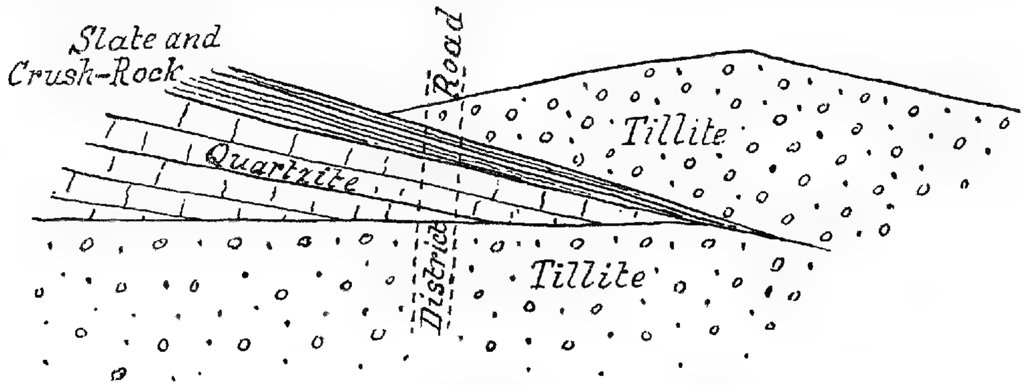


Fig. 3A.
Sketch Plan of Faulted Rock penetrating the Tillite.

usually occur in patches, leaving large areas destitute of conspicuous stones, but the matrix is very characteristic, having the features of a mudstone mixed with grit. The erratics noticed consisted of quartzite, granite, gneiss, etc., varying in size up to 2 feet in length, some of which were rounded, others angular. The eastern limits of this outcrop of the tillite is marked by the rising ground on the western side of the district road forming the boundary of Section 106. It crosses Ross' Creek at Res. No. 4 (near the butchers' killing yard). About half a mile from where the tillite is seen in the creek, there is a good exposure of slate in the creek; the slate is rotten with a dip of 70°, easterly. A reef of quartz 2 feet wide crosses the creek in this slate. The inference is that this slate which overlies the tillite is the representative of the Tapley's Hill Series, as occurs in the River Sturt. The tillite on the north-eastern side of Ross' Creek appears to be out of line with the more extended strike of these beds as they occur on the westerly side, and are, possibly, thrown out of line by a dip fault.

On the district road that passes up the eastern side of Section 90—about one-third of a mile up from the main road—there is a steep rise where the road passes over a hard quartzite rock. The stone is speckled with white from the presence of kaolinised felspar, after the manner of the Mitcham quartzite. The dip is high, approximately vertical, and the bed has about 30 yards of outcrop.

Blue slate and tillite are seen on its northern side and the quartzite seems to run out to the eastward. The blue slate just mentioned is ferruginous and develops

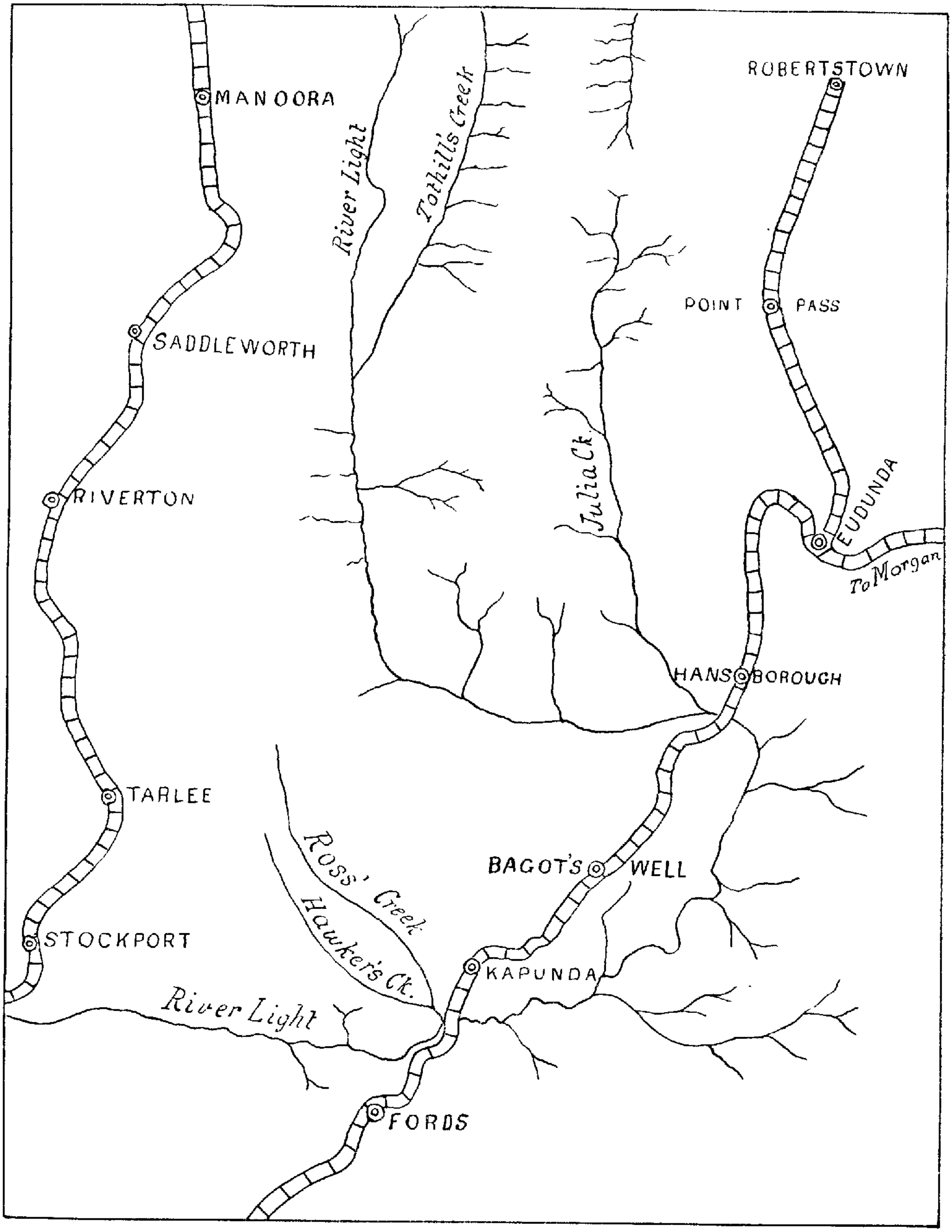


Fig. 4.
Locality Map of the Northern Areas described.

"crush rock" in places, and is bordered again by quartzite on its northern side, followed by a repetition of the tillite as shown in the sketch plan fig. 3A.

We have now to follow the line of strike of these beds on the westward side of Ross' Creek. In Section 119, an extensive exposure of the tillite is seen on the south-western side of the creek, close to the eastern side of Mr. Wilson's house. The tillite is mostly sandy and gritty, the grit in some places being very coarse—erratics scarce. On the eastern side of the same Section there is a small washout in which the tillite is exposed, and, resting on it, were a number of large granite erratics, four of which exceeded 2 feet in length, and one 3 feet, besides smaller examples. The stones had apparently been gathered from the adjoining land and placed in the washout to check the eroding action of the water. One of the largest had apparently been broken, and originally formed, with three others, a single large boulder. On the north-western side of Mr. Wilson's house a small creek exposes a section of rotten slate in vertical position, apparently "Tapley's Hill" Series.

Outcrops of tillite extend from the south-westward banks of Ross' Creek to the top of the hill on that side. From this vantage point, looking across low ground, the glacial beds can be seen to occur along the line of strike, for at least a mile, forming a scarp, facing eastwards. This is in a direct line with the same beds that occur in Hawker's Creek, two miles to the southward.

The beds can be followed along the same line of strike in an opposite direction (namely, to the N.N.W.). They are seen on the district road that passes between Sections 123 and 124, opposite to the reservoir enclosure, and about a quarter of a mile from the main road. They have a S.S.E. and N.N.W. direction, and, after crossing a wideish valley of alluvium, reappear on the other side, passing into Section 122, where they make a bold outcrop with four other smaller exposures within the Section. Several granite boulders were noticed here, some included in the tillite and others loose on the ground. One of these was a foot in length, and another, an aplite, measured 1 foot 5 inches.

Along the same line of outcrop, in a northerly direction, exposures occur in Section 124, but are not seen again till on the high ground in Section 85, situated within the reservoir enclosure. [To reach this spot, pass up the district road on the western side of the reservoir grounds, enter paddock just before reaching the Government nursery.] A strong quartzite, apparently vertical in position, is present, on the face of the hill, with the tillite on its western side. The latter is very slaty and only in places shows the characteristic gritty matrix and small erratics. The tillite appears to be cut off on its southern side by a quartzite, just below the crest of the hill.

From this point the strike of the beds can be followed for a mile, or more, in a N.N.W. direction, when strong outcrops of the tillite are again met with in Sections 96 and 97, near the boundary of the Hundred. Erratics are small and rather scarce.

HAWKER'S CREEK, HUNDRED OF KAPUNDA.

(Observations made in July, 1905.)

Hawker's Creek takes its rise a little to the southward of the Kapunda reservoir and follows the eastern base of the range that divides the Hundreds of Light and Kapunda. Its course is, approximately, parallel with that of Ross' Creek (at an average distance apart of about one mile), to which latter it becomes an affluent shortly before the joint stream reaches the River Light.

The Tillite.

The main strike of the glacial beds, which we have already described as passing through the Kapunda reservoir enclosure, in a S.S.E. direction, follows the Hawker's Creek for about two miles. The beds are well seen on Mr. W. J.

Hazel's grounds, who has his homestead on Section 134, close to the creek. Here the glacial grits have largely become disintegrated and gone down to soil. An exception to this is seen in a strong line of outcrop consisting of immense rounded masses which stand considerably above the level in cultivated ground. The bed does not show many erratics *in situ,* although a few were noticed, one of which was a triangular lump of granite, a foot in length. Numerous erratics were visible in a loose condition in the cultivated ground.

One large boulder of granite, nearly level with the ploughed ground, showed an exposed face 2 feet in width. A miner had sunk a shaft adjacent to the boulder with the hope of finding minerals. The stone proved to be 4 feet 6 inches, by 5 feet 6 inches, by 3 feet. It is angular in outline and fixed in a peculiar light-coloured matrix. On being tested, the latter was found to consist largely of the carbonates of lime and magnesia. The texture of the bed is flaky, closely packed, and mylonitic. Fixed in this matrix were numerous, mostly small, erratics of dolomitic limestone. Other erratics, consisting of granite and gneiss, measuring, respectively, 3 feet and 3 feet 6 inches, had been removed from the ploughed land to the fence, while others have been used in the construction of buildings.

The lithological characteristics of the tillite in this locality are quite unique for South Australia, so far as the author's experience is concerned. The association of the dolomitic erratics with a similar matrix at once suggested that we have here the parent rock transported by glacial action together with the ground-up material of the same limestone as forming the rock base of the tillite. To test this point to a certainty, Mr. W. S. Chapman, Analyst and Assayer at the School of Mines, kindly undertook to analyse the tillite and its associated calcareous erratics, with the following results:—

Description.	Dolomitic Tillite.	Dolomitic Erratic.
Water at 100°C.	0·10 per cent.	Nil
Water above 100° C.	1·66 ,, ,,	0·64 per cent.
Silica	36·64 ,, ,,	46·00 ,, ,,
Ferric oxide	2·90 ,, ,,	1·14 ,, ,,
Alumina	4·80 ,, ,,	0·68 ,, ,,
Lime	16·75 ,, ,,	15·72 ,, ,,
Magnesia	10·79 ,, ,,	11·02 ,, ,,
Carbon dioxide	24·84 ,, ,,	24·36 ,, ,,
Alkalies	Not determined	Not determined
	98·48 per cent.	99·56 per cent.

The above analyses leave no doubt that the local tillite, as a whole, had been gathered from one bed of impure dolomitic limestone. The differences in the two columns can be explained from the likelihood that the tillite gathered a small amount of earthy material (probably from the percolating water at the bottom of the glacier), the wonder is that the differences are so slight. The high proportion of silica present is explained from a clastic element in the parent rock. A portion of the limestone was treated with acid until all the carbonate elements were discharged, when a skeleton of clear, granular silica was left as a residuum, suggesting an arenaceous origin for the silica in the parent rock. A portion of the matrix was similarly treated, when it was seen that the residual silica was in a finely triturated condition as might be expected from the mylonitic action to which it had been subjected.

There is also a wide outcrop of rounded tillite, close to the road in Section 137, which it crosses, and is said to occur in the bottom of Hawker's Creek, in a line with the general strike to the N.N.W. Lower down the creek, the tillite is situated to the eastward of the creek, and slates occur in the latter.

FIG. 5. DIAGRAMMATIC GEOLOGICAL SECTION THROUGH THE TARLEE AND KAPUNDA DISTRICT—SECTION 9 MILES

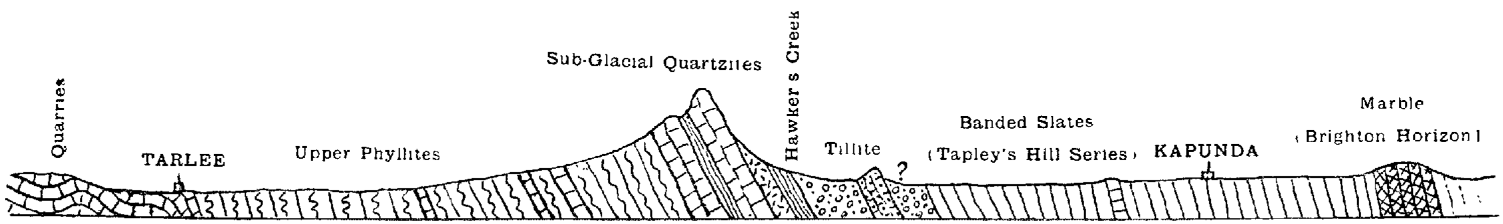
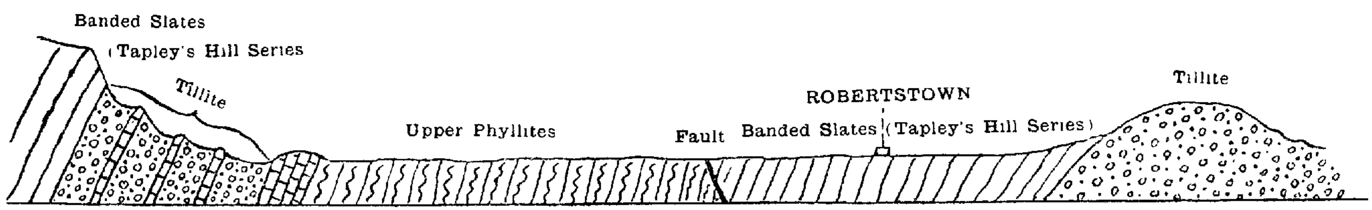


FIG. 6 DIAGRAMMATIC GEOLOGICAL SECTION OF THE EASTERN SCARP OF THE MOUNT LOFTY RANGES, NEAR ROBERTSTOWN—SECTION 4 MILES.



Beds Underlying the Tillite at Hazel's.

The strong quartzite range that makes the boundary between the Hundreds of Kapunda and Gilbert, continues in a south-easterly direction, dividing the Hundreds of Kapunda and Light, and passes a little to the westward of Mr. Hazel's farm. The stone is similar to that exposed in "The Gap," further to the north, is very siliceous and of the Mitcham type. The range shows a dip slope to the eastward, but is steep to the westward, and overlooks the Stockport plain. In its upper members it passes into a bluish quartzite (fig. 5).

Towards the base of the range, on its eastern side, there is an important fault rock, in the form of a fault breccia, composed of angular fragments of the quartzite, sometimes cemented by oxide of iron into a ferruginous breccia, with a width of about 200 yards. This probably indicates an important downthrow of the glacial beds by which they may have been partly obscured. Down on the flat in the neighbourhood of the creek, slates are exposed, followed by the tillite.

Beds Overlying the Tillite.

On the eastern side of the tillite the ground rises to a rocky ridge in which the stone is of a varied arenaceous type. It is sometimes a soft sandstone, and changes from that to a grit, or a quartzite. It overlies the tillite and may possibly be a glacial grit. It has been quarried for building purposes. The dip of the beds in the quarry appears to be E. 40° N. at 70°.

Beyond the grit-sandstone ridge, going eastward, is low country with few rock exposures, but these indicate that the bed rock is mostly slate. In Section 1488, near the bridge that crosses Ross' Creek, three-quarters of a mile to the westward of Kapunda, is a fine-grained bluish quartzite, or argillaceous quartzite, strongly contorted along the strike. In a cutting on the road above the bridge, shale is exposed that has the characteristics of the Tapley's Hill shale, having a general dip E. 10° N. at 55°, but the beds roll considerably and are cut by a strongly-defined quartz reef that is 2 feet 6 inches wide. In Section 1490, situated a little nearer to Kapunda, there is a fine-grained, laminated, sandy shale having a dip E. at 50°. The bed swings round in the same quarry with an increase of dip to between 70° and 80°. An old mine-quarry, near Kapunda, shows rotten, laminated shales with a dip S.W. at 35°. In the open cut, near the township, the strata dip W.N.W. at 30° and swing around to the E. Probably a dome structure, crossed by a fracture in which the copper ore has been deposited.

The "Tapley's Hill" slates continue, in an easterly direction, from the township of Kapunda as far as the River Light. Following the Truro road from Kapunda the bridge over the river is reached in a little more than five miles. Just before reaching the bridge a marble quarry is situated on the left-hand side of the road, nearly opposite the bridge. The marble is seen, in outcrop, from the road, over a width of 50 yards to the face of the quarry. Dip E. at 65°. At three-quarters of a mile along the road from the above-named bridge, another quarry in the marble occurs showing a dip N.E. at 43°. The two exposures mentioned form part of the "marble range" which extends in a S.S.E. strike through the greater part of the Hundred of Belvidere, and includes the quarry from which the stone was obtained for the building of the new Parliament House in Adelaide. It is clear from the associated rocks in the section (see fig. 5) from Tarlee through Hawker's Creek and Kapunda, that the marble range, usually called the "Kapunda marble," represents the Brighton Limestone horizon. It is interesting to note that the limestone which at Brighton is dark coloured and only slightly altered, in the Belvidere region, in a more easterly direction, the same limestone has undergone a crystalline metamorphism and converted to a marble.

NEAR FORDS ON THE RIVER LIGHT.

(Observations made July 24, 1908.)

The older tillite is not seen to the northward of Adelaide until exposed in a railway cutting near Fords, a small railway station on the Kapunda-Morgan branch line, which diverges from the main north line at Roseworthy. Fords is situated 44 miles from Adelaide and is 706 feet above sea level.

The beds, after being cut off by an east-west fault in the Viaduct Gully (see *ante*, p. 335), are thrown down to the great rift valley of the gulf and obscured by a great thickness of newer sediments. The ranges on the eastern side of the rift-valley, taking in the Gawler escarpment, are composed of slates, quartzites, and impure limestones, which belong to a lower horizon than the tillite, and the latter, with the exception of the small exposures at Springbank, only reappears near Fords, as stated above.

Beds Underlying the Tillite at Fords.

First Cutting.—Following the railway from Fords station, in a north-easterly direction, the first railway cutting is met with at a distance of 20 chains. The rock in the cutting is a fine-grained mica schist; or, in part, a clay slate. Most of the rock is penetrated by decayed acicular crystals which show on the surface of the stone and are indicated by slight cavities stained yellowish-red in the body of the stone. Some of the crystals (which are occasionally preserved) are dark coloured and longitudinally fibrous, suggesting actinolite. In part, the shales are spotted, and, in one place, a much decomposed knotted schist, in a bed 7 feet wide, shows a remarkable surface of "knots" in relief, which are also weathered out in great numbers as free bodies. The dip varies. The beds roll, in places, as isoclinal folds. The average dip is W. 20° N. at 55°.

Limestone is seen in two outcrops (apparently repeated). One of these crosses the railway a little to the eastward of the first cutting. It occurs as low exposures in fallowed ground on the northern side of the railway, where it appeared to be about 26 yards in surface diameter. It crosses the railway to the southern side, and on account of its stony nature has been left as unploughed patches in the cultivated field. Very large stones from the outcrop have been brought from the land to the fence. General strike, about east and west.

The other limestone outcrop is seen on the rise, to the southward of the one just described, and also to the southward of the railway, from which it is distant about a quarter of a mile, in ploughed ground (Section 397, Hd. of Light). It occupies two large circular spaces that have been left unploughed. The western space, about 60 yards in diameter, is occupied by an impure dolomitic limestone, that shows characteristic weathering; while the eastern one, which is the larger of the two, is a somewhat rotten ferruginous rock. General strike E. 20° N. (dip N. 20° W. at 55°). The beds seem to be cut off in an easterly direction as the ploughed ground, for a considerable distance, shows no signs of rock at the surface. The limestone varies in colour from blue to yellow, brown, and, at times, marble-like. It is an interesting bed, having undergone considerable metamorphism. Mica is generally distributed throughout, while a special feature of the various kinds of limestone, and also the ferruginous rock, is the large number of conspicuous crystals that they carry, which are in strong relief on weathered surfaces. The crystals are in the form of prisms, approximately square in transverse section, varying in size, with an average length of 30 mm. and a diameter of 5 mm. The surfaces of the prisms are rough through the deposit of quartz grains. The interiors appear to include both mica and free quartz in varying proportions. Mr. W. S. Chapman, of the Assay Department of the School of Mines, has kindly

supplied the following analysis:—SiO_2, 62·5; Al_2O_3, 27·6; Fe_2O_3, a little; CaO, 1·6; MgO, a little; Na_2O and K_2O, present=91·7. The form of the crystals is suggestive of Andalusite, but the analysis shows too high a percentage of silica for this mineral. It is probable that Andalusite was formed, in the first instance, and was subjected, later, to metasomatic reconstruction; in some cases, forming pseudomorphs after Andalusite. The limestone can be correlated with the "Blue metal" limestone, of the Adelaide Series, a bed that occurs in the Upper Phyllites, and is inferior in position to the Glen Osmond quartzite.

Second Railway Cutting.—Half a mile further on than the first cutting from Fords railway station a second cutting occurs in laminated, decomposed slates. At the first (or western) end of the cutting there is a bed of very fine-grained, light-coloured sandstone in which there are numerous perfectly parallel dark lines, probably of slate, that show in strong contrast to the lighter portions. The dip is N. 20° E. at 50°. The main part of the cutting consists of dark blue, to black, rotten shales. The dip is similar to that at the western end, but is almost obliterated by crush and intense jointing. Thin lines of iron oxide and calcite run in all directions. A few quartz veins, up to a foot or more in thickness, intersect the beds.

Third Railway Cutting—This shows a continuation of the slates. The excavation is at the 45-mile post from Adelaide.

Fourth Railway Cutting.—This cutting is in Glen Osmond-Mitcham quartzite. The stone is a continuation of the boundary range that follows a south-easterly direction, from "The Gap," east of Tarlee, passes Mr. Hazel's, at Hawker's Creek, and curves round to the River Light, which it crosses at the point where the boundaries of the Hundreds of Light, Kapunda, and Belvidere meet. The rock makes a strong precipitous face on the northern side of the Light, where it has a dip N.E. at 80°, and is about 150 feet in thickness. In the railway cutting the quartzite is faulted and reduced in thickness. Overlying the quartzite are laminated shales which, with some stronger beds, continue for about one-third of a mile. The quartzite range loses much of its prominence after crossing the Light, and is known as the Gap Hills. In passing into the Hundred of Belvidere, Section 536, the ridge is more marked and has several small quarries. Dip N.E. at 45°.

The Tillite.

Fifth Railway Cutting.—Following the laminated shales (or slates) are the glacial beds, in superior order. The latter make a strong feature in the northern bank of the river and they occupy a similar stratigraphical position to the main quartzite ridge as occurs further to the northward at Hazel's, and on the Tarlee-Kapunda road. The beds cross the railway at the fifth cutting, in which is the 45½-mile post. The glacial features are mostly either fine-grained tillite or quartzites. Erratics are relatively scarce and occur mostly in groups, and are most plentiful near the lower part of the tillite. One granite erratic, in No. 5 cutting, measures 3 feet. The tillite, which is about half a mile in extent, continues through the next cutting.

Sixth Railway Cutting occurs at the 45¾-mile post. In this section the beds consist mostly of a coarse, friable grit, varying to a dark-coloured clay with stones. Towards the far, or eastern, end of the cutting, the beds show remarkable contortions in a series of sharp folds and minor puckerings rendered conspicuous by their dark outlines. On the top of this section is a coarse gravel bed containing large stones in sand in a position 100 feet above the present level of the River Light. The tillite passes up into laminated shales of the Tapley's Hill Series which are continuous to Kapunda.

EUDUNDA, HUNDRED OF NEALES.

(Observations made on March 30 and April 1, 1907.)

We have already described a series of outcrops of the tillite which maintain a practically continuous strike in a S.S.E. direction from Sections 96 and 97 on the boundaries of the Hundreds of Gilbert and Kapunda, to Fords, on the River Light, over a distance of seven miles in a direct line. We have now to refer to another, and practically parallel, line of exposures in the Hundreds of Neales and English, situated about 16 miles to the eastward of those described above and following a similar S.S.E. strike.

The watershed that defines the boundary between the Hundreds of Julia Creek and Neales consists of banded slates and grits which can be correlated with the Tapley's Hill beds. The tillite rises from beneath these slates and forms a broad zone of outcrop on the western side of the Hundred of Neales and includes within its area the travelling-stock road.

The tillite is exposed in a quarry on the hill side, in Section 131, on the north-eastern side of the township of Eudunda. The stone is a rotten, pinkish, sandy grit, showing a strike S. 30° E. The ground mass is marked by numerous pinkish-coloured lines, which are often very irregular and contorted. The erratics are mostly small, but two noted in the quarry were a foot in length; the boulders consist of rotten granite, quartzite, felspathic grit, slate, etc. A strong, thick quartzite underlies the tillite at the quarry (dip W. 30° S. at 73°), which may be either a bed within the tillite; or, what is more likely, the subglacial quartzites which commonly underlie the tillite.

The town of Eudunda is built on the flattish ground which has resulted from the decomposition and waste of the soft tillite. The railway near the township is on the junction between the tillite and the banded slates. In the first railway cutting, on the westward side of the town, are slates with gritty bands and a few erratics. The latter are mostly small and rather scarce, but some were seen up to 6 inches in length. It has the appearance as though the tillite passes up gradually into the Tapley's Hill slates. Dip S.W. at 50°.

Following in a westerly direction through the paddocks, the slates make prominent outcrops and are sometimes calcareous, with an increasing angle of dip up to 82°, and, in places, reaches 90°. At two and a half miles from the town, in a south-westerly direction, the beds change to gritty sandstones and the strike alters to N. 20° W. with a westerly dip.

The south-easterly road from Eudunda runs, for a short distance, by the side of a small creek or ditch, in which the tillite, interbedded with quartzites and slates, is seen, and has a width across the strike that can be traced for several hundred yards. Following the stock-travelling road, which runs parallel with the range in a south-easterly direction, the tillite was found to skirt the hill, forming the foot-hills of the range, and extending across the wide road as far as Foote's Creek, and the Stock Reserve on this creek. Here the hills change their direction, somewhat, with a westerly twist, and the tillite takes on a due south strike cutting the road which runs to the top of the range in a north-north-west direction, past Narcoota, on the southern boundary of the Hundred and the homestead of Mr. E. S. Smith, of Tablelands.

At Mr. Smith's the tillite gives place to the quartzite, which makes bold ridges and pinnacles, showing a dip, easterly, at 55°. A little further up the road the tillite puts on again, on the rise of the hill. Numerous granite and quartzite erratics are included in the bed on the road up to about the summit of the hill on the line of division between the Hundreds of Neales and Julia Creek. This

repetition of the tillite arises either from a strike fault, or otherwise from an anticlinal curve which brings up the underlying quartzite into the axis of the fold and has been uncovered by denudation. On the western side, the Tapley's Hill slates occur in regular order.

The range, in which the tillite and associated underlying quartzite form a ridge, runs parallel with the Murray flats, but there is another broken range, nearer the flats, about six miles to the eastward of the former, but this was not visited by the author.

ROBERTSTOWN AND POINT PASS IN THE HUNDRED OF ENGLISH.

(Observations made in May, 1915.)

The physiographical and geological features that occur in the Hundred of Neales are continued through the adjoining Hundred of English on its northern side. The boundary range, with its tillite, on the western side of Neales, is continued as the dividing range between the Hundreds of English and Julia Creek, with similar geological features.

ROBERTSTOWN.

The village is situated on a plain with ranges of hills on either side that have an approximately north and south direction. The valley consists of cultivated land with a little surface limestone. The hills on the western side rise about 300 feet above the level of the plain and have the characteristics of a broken and incised peneplain. It is a distance of four miles from Robertstown to the top of the scarp which has a sharply-defined edge (see fig. 6).

The upper part of the scarp consists of a banded slate that is more indurated than that at Tapley's Hill and the bands are narrower. The beds make a strong outcrop at the upper and steepest part of the scarp and have a strike N. 20° W. At a point opposite the road the strike is due N., but soon returns to normal. The dip is high, probably between 60° and 70°.

Underlying the banded slates is a thick development of the tillite. The ground mass is a variable, granular, to bluish slaty rock, and, in places, takes the form of a coarse grit. Thin bands of dolomitic limestone occur in it, as also three thin quartzite beds which make prominent ridges in the tillite (fig. 6). It carries less detrital constituents than most localities and relatively fewer erratics. The best examples are found scattered over the slopes on cultivated land, or where they have been gathered off the ground by the farmer and carted to the fence. The erratics vary in size, so far as seen, up to 1½ feet in length. Of these, the hard siliceous quartzites are the most common and reach the size named. Several varieties of granitoid rocks were noted, including granulite, aplite, and gneiss. A coarse-grained augen gneiss measured 15 inches in all directions. Several erratics of a white or cream-coloured marble were seen in the face of the rock that had been much reduced in size by weathering and rested in sockets. No scratched stones were noticed, but this can be explained for the reasons that the granites were more or less in a state of decomposition, while the hard quartzites were covered by a sericitic or chloritic skin, induced by crush and metamorphic action.

At a few hundred yards from where the tillite becomes obscured by soil, a low hill of quartzite rises in the cultivated paddock, which probably represents the subglacial quartzites as seen in other localities.

Eastern Side of Robertstown.

At a distance of one and a half miles to the eastward of Robertstown, and five miles from the western range, is another parallel range of hills of about the same height. Unlike the former the hills make no scarp, but have rounded outlines in subdued relief; and their geological structure shows that they are a repetition of the eastern range, in the form of a faulted block, with a downthrow to the east. The exact position of the fault cannot be determined on account of the alluvial cover of the plain.

Following the eastward road from Robertstown, for about half a mile, banded shales show in small cuttings and on the road with much surface travertine which obscures most of the underlying rocks. At the first rise in the road the tillite begins to show itself in the cultivated fields, on the road, and in heaps brought to the fence by the farmers. In nearing the top of the rise the paddocks are literally covered with the fragments, which are mostly flat from the breaking down of the tillite along its cleavage planes. On the eastern side of the range the tillite outcrops in numerous small ridges, with scores of large heaps of stones which the farmers have gathered from the land, and there are still so many left on the ground as to make cultivation almost impossible. The included erratics are similar to those seen on the western range, numerous quartzites occur, up to 18 inches in diameter, together with a few granites and limestones. One or two feebly-scratched boulders were obtained; many of the quartzites showed pressure striae.

The tillite on this side of the valley is very typical, much more so than on the western side. It has apparently an east and west strike, which must be local, and may account for its apparent great width, which is fully three-quarters of a mile, occupying the whole of Section 216, and more. The strike of the cleavage is 35° E. of S. at 90°-80° westerly. It occupies the eastern slope of the range down to the Murray Plains.

POINT PASS.

The township of Point Pass, unlike that of Robertstown, is situated immediately at the base of the scarped range that runs from Eudunda to beyond Robertstown, in a northerly direction, the distance between the two townships, in a straight line, being six miles. There is also an eastern range of hills opposite Point Pass, as at Robertstown, but while the latter is on the eastern side of the intervening plain, Point Pass is on the western side. At Point Pass the width of the plain, on the flat, is three miles, or four miles between the respective heights.

At Point Pass the scarp face is more broken by denudation with longer slopes which permit wheeled traffic to reach the edge of the plateau in a rise of, say, 500 feet in about a mile. No such road is possible at Robertstown.

The drainage has not yet cut back through the scarp sufficiently far to capture the streams of the plateau, and, in consequence, the drainage is in a very juvenile stage. Numerous mountain torrents come down the face in heavy rains. These are consequent streams following the uplift—or perhaps, taking into consideration the downthrow of the eastern range, the sinking down of the plain on the eastward side. The absence of any transverse (subsequent) streams to carry the waters off by a north and south drainage is remarkable—there is not even a gutter in that direction. The streams from the hills, which are very numerous, debouch on the plain, which is almost wholly under cultivation, and have a tendency to go southwards before absorption. The drainage of the plain (what there is of it) comes in from the north of Robertstown, passes over a broad flat on the western side of the township, and forms a series of temporary "lagoons" on its way to

Point Pass, which it passes on its eastern side, and is lost in the neighbourhood of Mount Eba. Small ridges divide the stream and by extensive spreading produce only slight damage to the ploughed land.

The geology of the neighbourhood is much like that of Robertstown. At the foot of the hills, in the creek that comes down from the hills close to the township, a slight exposure of the tillite occurs. The beds are, approximately, vertical, and exhibit, in places, typical sections of a gritty matrix, including small erratics, with bands of coarse grit—even the finer portions of the ground mass show a fine grittiness when viewed on a weathered surface.

The tillite passes up into bluish-black slate with bluish calcareo-siliceous bands which appear to be representative of the Tapley's Hill Series. At about half-way up the hill a yellowish-white, marble-like limestone occurs, having a thickness of about 9 feet. This can scarcely be correlated with the Brighton limestone, as it occurs not at the top of the series, as at Brighton, but interbedded with the bluish-coloured slates, but it may represent some of the impure limestones which underlie the Brighton limestone. There are also a few quartzites in the series, but of no great thickness.

The bed of the creek is choked for a considerable distance with a limestone of secondary origin. The older impure limestones which outcrop at higher levels in the creek have no doubt been the source from which this travertine deposit has been derived. A travertine of the normal type covers the slopes above the water line, but in the bed of the creek is a harder, more compact, sometimes bluish and sometimes brownish limestone which has, in many places, cemented the stones of the creek into a hard calcareous conglomerate. The limestone often carries cavities much like the limestones built up around the mound springs of the Lake Eyre region.

The Range on the Eastern side of Point Pass.

The hills on the eastern side of the plain, opposite Point Pass, are similar to those to the eastward of Robertstown, except from the special feature that they include a bold quartzite ridge which rises to a height of about 150 feet above the plain. Most of the plain, going eastward, is essentially a flood plain, having been built up by the flood waters referred to above, with much travertine in layers and nodular concretions.

The first rise on the eastern side takes the form of a low rounded ridge, no rocks are seen *in situ*, but the fields are covered with loose stones of quartzite.

In a second rise, which forms the slope to the main ridge, and within half a mile of the steep ascent, tillite becomes abundant as scattered flat pieces on the cultivated land and, with the associated travertine limestone, has been carted to the edge of the fields, or placed in heaps near the farmhouse situated at the base of the ridge.

Following the path that goes up by the farmstead to the top of the ridge, the tillite is seen in outcrop at the base and for two-thirds of the distance up, where it is displaced by a quartzite. Over the crest of the hill is a steep gully with another quartzite ridge parallel with the first. In between the ridges the tillite is again seen, its inferior hardness having led to the excavation of the gorge. The tillite does not make any prominent features on this side, but is distinguishable in exposures seen level with the ground as well as in the bed of a small creek where the cleavage has a strike of about north-west with a dip of about 5° westerly.

The quartzites which are answerable for the special prominence of the hill (or, rather, hills, as the ridge consists of several heights more or less isolated) are very irregular in their thickness and strike. On the first ridge ascended the strike

Rock Face of Sturtian Tillite near Eden Railway Station

Gillingham & Co. Limited, Printers, Adelaide

Fig. 1. Outcrop [illegible]

Fig. 2. As above, but taken from a different part of the field.

Photo. W. H.

Gillingham & Co. Limited, Printers, Adelaide.

was a few degrees west of north. These hard beds are cut off very suddenly on their southern side, the ridge being abruptly truncated where the road passes their southern ends and they do not appear again in the direction of the strike. The older rocks of the district are at a very high angle, practically vertical, as the dip varies slightly either to the east or west of the vertical.

No time was available to examine the ground on the eastern side of the range.

DESCRIPTION OF PLATES XIV. AND XV.

Plate XIV.

Portion of rock-face of Sturtian Tillite at small waterfall near Eden Railway Station.

Plate XV.

Fig. 1. Prominent exposures of Sturtian Tillite, near Ross' Creek, between Tarlee and Kapunda.

Fig. 2. Prominent exposures of Sturtian Tillite, near Ross' Creek, in a position slightly removed from those shown in fig. 1.

REVISION OF THE AUSTRALIAN ELATERIDAE.

COLEOPTERA.—Part II.

By Albert H. Elston, F.E.S.

[Read October 13, 1927.]

Lacon fergusoni, n. sp.

Elongate; slightly convex; moderately nitid; brown with reddish or ferruginous patches; antennae, posterior angles of pronotum, gula, parts of episternum, epipleurae and legs ferruginous; not densely clothed with small testaceous squamose hairs, more densely arranged on abdomen than elsewhere. Under surface of a more uniform brown, except parts mentioned above, and not having the mottled appearance of the upper surface. Head almost circular with the base more or less straight, with two median foveae, one interocular and the other just above the insertion of the antennae; with dense, round, somewhat deep punctures, which are more or less concealed by the clothing. Pronotum slightly wider than long, base triemarginate, sides from near base to the anterior fourth almost straight and parallel and then abruptly, roundly contracted to the anterior margin, barely perceptibly sinuate in front of the posterior angles, which are almost rectangular with the apices slightly obliquely truncated, and with a small protuberance inside each angle, anterior angles acute with a feeble longitudinal depression inside of each near the apex, the longitudinal furrow only just discernible on the basal half; with dense, round, moderately deep punctures, in parts concealed by the clothing. Scutellum pentangular, the basal angle obtuse. Elytra as wide as pronotum at the base and about twice as long, sides almost straight and parallel from the base to near the middle then gradually roundly contracted to apex; punctate-striate, the punctures in striae moderately large, deep and almost rectangular, the interstices flat and with dense punctures only slightly smaller than those in striae. Prosternum with moderately-deep, well-defined, metasternum with shallow tarsal depressions. Length, 8-10 mm.; width, 3-4 mm.

Queensland: Bowen (A. Simson); Townsville (E. W. Ferguson). Type, in author's collection.

At first glance somewhat resembling *L. marmoratus,* Cand., but is less convex, the punctures of pronotum smaller and more crowded, the striae on the elytra less distinct and the punctures of the interstices larger; it differs from *L. variegatus,* Schwarz, by having the posterior angles of the pronotum more rectangular and the punctures on the elytral striae larger; and from *L. plagiatus,* Cand., by being proportionately broader and flatter and with the punctures of the elytral interstices larger.

Lacon badius, n. sp.

Moderately thick; convex; subnitid; pale to dark castaneous, the head, anterior and posterior margins of pronotum and sides of scutellum dark brown; moderately densely clothed with short, depressed, golden hairs. Under surface same colour as upper and clothed similarly. Head with the surface almost flat except for a barely visible depression near the top, rather densely covered with moderately large deep punctures. Pronotum about as long as wide, moderately strongly convex, with a shallow, median, longitudinal furrow extending upwards from the base to quite two-thirds of the

length of pronotum; sides crenulate, roundly contracted on the anterior third and then almost straight to near base, which is only very slightly sinuate, posterior angles strong and somewhat divergent, apex rounded, with a small tubercle in the middle which gives the angles a pointed appearance, inside of the apex of each is a small elongate protuberance which makes the angles look as if they are bluntly carinate; closely covered with rather large, deep, round punctures. Scutellum vaguely pentagonal, the base being almost round rather than obtusely angled. Elytra as wide as pronotum and about twice as long, sides almost straight and parallel to just beyond the middle then gradually roundly contracted to apex, narrowly flattened on basal half near the suture; punctate-striate, the punctures in striae moderately large and deep, not crowded, the interstices flat and minutely punctured. Prosternum with deep, sharply-defined tarsal depressions, metasternum very vaguely impressed. Length, 8·5-10·5 mm.; width, 3-4 mm.

South Australia: Ooldea, Tarcoola (A. M. Lea). Type, in South Australian Museum.

A rather distinct species and readily distinguished by its colour and peculiarly constructed posterior angles of pronotum. At first glance it somewhat resembles *L. arbitrarius*, Elston, from which it can be easily separated by the shape of the posterior angles of pronotum; in the present species they are rounded at the apex, whilst in *arbitrarius* they are distinctly elongated and acutely pointed; also, in the latter species, the tarsal furrows on the prosternum are very shallow, not sharply defined.

Lacon cruentatus, n. sp.

Not thick; almost flat; nitid; black, with scattered small red blotches, antennae, mouth parts and legs testaceous; moderately densely clothed with short, depressed, griseous-yellow, squamose hairs. Under surface brown, more densely clothed than the upper, and with similar clothing. Head with surface even except for a very shallow depression midway between the insertion of antennae, densely covered with small punctures which are concealed by the clothing. Pronotum slightly longer than wide, lightly convex, without longitudinal median furrow, sides roundly contracted on the anterior third and then straight and parallel to near posterior angles, which are almost right angular and with a small shining tubercle on the inside of each angle, sides in front of the posterior angles very lightly sinuate, basal margin very nearly straight, only almost imperceptibly emarginate; densely punctured, the punctures moderately small and rather deep. Scutellum pentagonal, basal angle obtuse. Elytra as wide as prothorax and about twice its length, sides nearly straight and parallel to just beyond the middle and then roundly contracted to apex, lightly convex and slightly flattened in middle near suture; punctate-striate, the punctures in striae large, round and deep, interstices flat and with dense punctures only slightly smaller than those in striae. Prosternum with well-defined tarsal impressions, those on the metasternum almost obsolete. Length, 5-6·5 mm.; width, 2-2·5 mm.

South Australia: Lake Callabonna (A. Zietz), Oodnadatta. Type, in South Australian Museum.

A distinct species owing to the dark body with pale legs, the scattered blood-red blotches are mostly confined to the elytra. Its nearest ally is *L. pictipennis*, Cand., from which it can be distinguished by its darker ground colour, more nitid, the individual squamose hairs much finer, without a longitudinal median furrow on the prothorax, and head without interocular depressions. A more nitid species than *L. guttatus*, Cand., with a darker ground colour and punctures of elytral interstices larger.

Lacon stigmosus, n. sp.

Moderately thick; opaque; dark brown, antennae (except basal joint which is more or less reddish) and palpi testaceous, legs and gula reddish; rather densely clothed with brown and griseous squamose hairs, the latter appearing in patches and giving the upper surface a mottled appearance. Under surface dark brown in parts diluted with red; densely (on the abdomen more densely) and uniformly clothed with griseous squamose hairs. Head with triangular impression in the middle, base of which lies between the insertion of antennae, also a faint longitudinal one extending from the apex of the latter to the vertex of head; with dense, rather deep punctures which are more or less concealed by the clothing. Pronotum about as wide as long, moderately and evenly convex, with a short, barely visible, longitudinal furrow in the middle, sides roundly contracted on the anterior third and then almost straight and parallel to the base, lateral margins almost imperceptibly sinuate in front of the posterior angles which are almost rectangular and not truncated at apex, with two large, round, somewhat shallow foveae at the base, situated one on each side of the longitudinal furrow; with dense, moderately large, round, deep punctures which are in parts concealed by the clothing. Scutellum pentagonal, slightly concave and acuminate behind. Elytra as wide as prothorax and about twice its length, except for a very slight dilation in front of the middle, the sides are almost straight and parallel to beyond the middle then roundly and evenly contracted to apex, lightly and evenly convex, at base abruptly and obliquely sloping; punctate-striate, the punctures in striae moderately large, round and deep, the interstices flat with much smaller punctures. Prosternum with curved, deep, sharply defined tarsal furrows, those on metasternum very shallow and barely visible. Length, 10-11·5 mm.; width, 3·5-4·25 mm.

North-west Australia: Derby. North Queensland: Normanton (R. Kemp). Type, in South Australian Museum.

This is one of the mottled species, on some of the specimens the posterior angles of the prothorax are diluted with red and the parts of the elytra covered with the pale hairs are in some cases more or less reddish; the colour of the under surface varies, on some examples the dark brown colour predominates here and there diluted with red, whereas on others the whole of the under surface is a reddish-brown. This species comes nearest to *L. plagiatus*, Cand., from which it is easily distinguished by its denser clothing, more robust form, pronotum more evenly arched and not transversely ridged posteriorly and punctures in the striae of elytra much larger in proportion to those on the interstices.

LACON LATERALIS, Schwarz.

The author in his description of this species gave the habitat as Australia; I have before me four examples from North Queensland which may be regarded as the above species. The male is much smaller than the female; with the antennae reaching to the base of the prothorax, the latter appears to be more elongate and it also has the sinuation in front of its posterior angles more pronounced than that of the female.

Lacon semivestitus, n. sp.

Elongate; not thick; subopaque; dark brown with antennae, mouth parts and legs more or less ferruginous; upper surface not densely clothed, with minute tawny, squamose hairs. Under surface a reddish-brown and clothed similarly to the upper surface. Head with the surface widely depressed, the lateral margins appearing to be bent upwards; closely, deeply and somewhat

rugosely punctured. Pronotum slightly longer than wide, lightly convex, the longitudinal median furrow extending from near the base to the apex, along the lateral margins rather widely flattened, from just in front of the posterior angles the sides gradually curve outwards to the anterior third and then rather abruptly contracted to the apex of anterior angles which are subacute and rounded at apex, the posterior angles are slightly divergent and produced backwards with their apices minutely obliquely truncated, and with a more or less distinct lateral carina extending a short distance upwards; with large, moderately deep, closely placed, subreticulate punctures. Scutellum pentagonal, almost flat, dilated posteriorly and obtusely angled. Elytra slightly wider than across posterior angles of pronotum and a little more than twice its length, widely flattened on top, sides from base gradually, almost imperceptibly, dilated to beyond the middle and then gradually, evenly and roundly contracted to apex; punctate-striate, the punctures in striae large and deep, the interstices narrow and minutely punctured, the alternate ones distinctly elevated. Pro- and metasternum without tarsal furrows. Length, 12·5-15·5 mm.; width, 3·5-4·5 mm.

North-west Australia: Wyndham (W. Crawshaw). North Queensland: Townsville (G. F. Hill). Groote Eylandt (N. Tindale). Type, in author's collection.

A rather distinct species, the narrowest part of the pronotum is just in front of its posterior angles; the bottoms of the elytral punctures when viewed in a bright light are a vivid red; the prosternum on some specimens is very widely and very faintly impressed, but these barely visible impressions could not be regarded as tarsal furrows. This species cannot be easily associated with any other member of its group.

Lacon conspiciendus, n. sp.

Moderately thick; subopaque; dark brown with here and there reddish patches, antennae (except basal joint which is infuscated) and legs reddish; rather densely clothed with short, dark and pale squamose hairs, the latter mostly confined to the reddish patches which gives the insect a mottled appearance. Under surface brown with the gula and epipleurae more or less reddish; moderately densely clothed with small, depressed, golden squamose hairs. Head lightly impressed and densely covered with moderately large, deep, rugose punctures. Pronotum wider than long, transversely gibbose behind the middle, with a short longitudinal furrow more or less distinctly dividing the gibbosity, sides from in front of the posterior angles almost straight and parallel to the anterior third and then abruptly, very nearly rectilinearly, contracted to apices of anterior angles which are acute and faintly impressed on the inside, lateral margins crenate and when viewed from the side with a feeble carina extending almost the whole length, lightly sinuate in front of the posterior angles which are very slightly divergent and very widely and obliquely truncated; with dense, round, rather deep punctures more or less concealed by the clothing. Scutellum pentagonal, slightly concave; with shallow, rugose punctures. Elytra a very little wider than base of prothorax and only slightly more than twice the length of the latter, evenly convex and sloping obliquely at the base, sides feebly dilated near the middle and on the posterior third gradually and evenly contracted to apex; punctate-striate, the punctures in striae moderately large and deep and closely placed, the interstices flat, closely and minutely punctured. Prosternum and metasternum with shallow tarsal depressions, those on the former more distinct than those on the latter. Length, 7-8·5 mm.; width, 2·5-3 mm.

Queensland: Brisbane. North-west Australia: Kimberley district (Dr. E. Mjöberg). Type, in South Australian Museum.

This insect is chiefly conspicuous by the wide and oblique truncation of the posterior angles of the prothorax, which at first glance seem to be rectangular, this truncation makes them appear biangular, the top angle being obtuse and the bottom one acute, and on some specimens can be seen more distinctly than on others a faint lateral carina. The reddish patches are mostly confined to the elytra and the posterior angles of the prothorax are consistently of this colour; these reddish patches are much more conspicuous when the insect is abraded; the clothing on the basal fourth of the elytra has a granulated appearance. At first glance this species might be confused with *L. marmoratus,* Cand., but can be easily distinguished, *inter alia,* by its much shorter clothing, comparatively narrower form, punctures in striae less conspicuous under the clothing, sides of pronotum more distinctly flattened and the scutellum more elongate.

Lacon bellator, n. sp.

Elongate; moderately thick; subopaque; dark reddish-brown with the antennae and legs ferruginous; not densely clothed with short, depressed, testaceous, squamose hairs. Under surface a little more diluted with red and with clothing similar to the upper surface but slightly denser. Head with very prominent mandibles, widely impressed and with large, deep, reticulate punctures. Pronotum longer than wide, moderately and evenly convex with a faintly impressed longitudinal median furrow, inside the lateral margins narrowly flattened, sides from in front of the posterior angles gradually dilated to in front of the middle and then roundly contracted to apices of anterior angles which are widely and rather deeply impressed on the inside, posterior angles small, very slightly divergent and produced backwards, acute and with a faint lateral carina extending upwards for a short distance along the sides of pronotum; with large, deep, not closely placed punctures. Scutellum pentagonal, slightly concave, posterior angle obtuse and rounded; with a few scattered, deep punctures. Elytra narrower than pronotum between apices of posterior angles and about twice the length of the latter, lightly convex, a narrow margin on either side of suture depressed, sides almost straight and parallel to beyond the middle and then gradually and evenly contracted to apex; punctate-striate, the punctures in striae large, deep and rectangularly elongate, interstices flat and minutely punctured. Prosternum without tarsal furrows. Length, 12·5-13 mm.; width, 4-4·25 mm.

Northern Territory (collection South Australian Museum). Type, in South Australian Museum.

A distinct species; the pronotum has a very characteristic shape, its width between the apices of the posterior angles is about the same as that between the apices of its anterior angles, the clothing on the interstices of the elytra is arranged in two more or less distinct longitudinal rows. There are very faint depressions on the prosternum which are really rudimentary forms of tarsal furrows, these, however, I am not regarding as such, for this form undoubtedly belongs to, or at least is so closely associated with the group that has no tarsal furrows that, for the purpose of tabulation, I think it desirable to group them altogether. In general appearance the present species somewhat resembles *L. palpalis,* Cand., but can be easily distinguished by its scantier clothing, sides of pronotum not so widely depressed and its punctures smaller and not so closely placed, the posterior angles of pronotum smaller and not so divergent and the punctures on the interstices of the elytra much smaller.

Lacon praelongus, n. sp.

Elongate; not thick; subopaque; brown with the antennae, posterior angles of pronotum and legs ferruginous; moderately densely clothed with very short, griseous-yellow squamose hairs which are arranged in double rows on the elytra. Under surface of a more reddish brown than upper surface and similarly clothed. Head with a very large, not deep, triangular depression and densely covered with small, almost reticulate, punctures. Pronotum as wide as long, very lightly convex; the shallow, longitudinal median furrow only distinct behind the middle, the lateral margins slightly crenulate and straight and parallel from near the base to the anterior fourth and then abruptly, almost rectilinearly contracted to apices of anterior angles which are acute and strongly depressed on the inside, the sides are barely sinuate in front of the posterior angles which are small, very slightly produced backwards, acute and lightly depressed on the inside; with dense, reticulate punctures, larger than those on the head. Scutellum elongate, pentagonal, truncate in front and obtusely angled behind, with moderately dense, rugose punctures. Elytra very slightly wider than across posterior angles of pronotum and nearly thrice the length of the latter, flattened in the middle, sides almost straight and parallel from near the base to the posterior third and then gradually roundly contracted to apex; punctate-striate, the punctures in striae rather deep and larger than those on pronotum, the interstices narrow, densely and minutely punctured, the alternate ones not at all elevated. Prosternum and metasternum without tarsal furrows. Length, 10·5-11·5 mm.; width, 3-3·5 mm.

Queensland: Cunnamulla (H. Hardcastle). Type, in South Australian Museum.

A very elongate and distinct species; owing to the large depression the head appears concave; the pronotum seems to be longer than wide, although by measurement it is only as long as wide, on one specimen, presumably a female, the pronotum is slightly more convex which gives it a more quadratic appearance.

This species comes nearest to *L. variabilis*, Cand., from which it is distinguished by being much more elongate and narrower in proportion, sides of pronotum not so widely depressed and only barely perceptibly sinuate in front of the posterior angles which are much smaller, slightly produced backwards and acute; the punctures on the elytra are smaller, the interstices flat and the alternate ones not at all elevated. It differs from the description of *L. monachus*, Cand., by being more elongate, more or less depressed, the pronotum not wider than long and not tri-impressed and the alternate elytral interstices not elevated. It is distinguished from *L. parallelus*, Cand., with which it might be confused owing to the similar elongate appearance, chiefly by the shape of the pronotum and the sides of the prosternum not at all impressed for tarsal furrows, less convex and the punctures in the elytral striae much larger.

Lacon farinosus, n. sp.

Moderately convex; slightly nitid; dark brown, in parts diluted with red, antennae testaceous, posterior angles of pronotum, base of elytra, scutellum and legs more or less reddish; not densely clothed with small, depressed, cineraceous, squamose hairs. Under surface same colour as upper, except epipleurae of elytra which are reddish, and similarly clothed. Head with a rather large, triangular, shallow depression near the middle; with densely arranged, deep, almost reticulate punctures. Pronotum barely longer than wide, evenly and lightly convex, abruptly sloping backwards on the posterior fourth; with a shallow, median, longitudinal furrow extending nearly the

whole length, more distinct posteriorly; lateral margins from in front of the posterior angles almost imperceptibly rounded to the anterior third, then curvilinearly contracted (not strongly) to the apices of anterior angles which are acute and rounded; posterior angles acute, very slightly divergent and produced backwards beyond the humeral angles of elytra, depressed on the inside, with a strong carina inside the lateral margins and extending upwards nearly to the middle of the pronotum; with densely arranged, large, deep, reticulate punctures. Scutellum pentagonal, lateral margins lightly constricted near the middle, posterior angles very obtusely pointed, almost rounded, with a few large, round punctures. Elytra at base narrower than across posterior angles of pronotum and about twice the length of the latter, lightly convex and slightly flattened near the suture, sides barely perceptibly dilated near the middle then roundly contracted to apex; punctate-striate, the punctures in striae moderately large and deep, interstices flat with inconspicuous, minute, shallow punctures except on the basal third where they are larger and deeper and give this part of the elytra a granulated appearance. Prosternum and metasternum without tarsal furrows. Length, 10-11 mm.; width, 3·5-4 mm.

Northern Territory: Port Darwin (W. K. Hunt). Type, in South Australian Museum.

This species should be easily distinguished by the shape of the pronotum, the posterior angles of which extend backwards beyond the humeral angles of the elytra; near the suture and base of elytra the dark brown ground colour is strongly diluted with red and the posterior angles of pronotum and scutellum are a more or less bright red with the margins of each infuscated. One specimen is a much lighter brown than the type but this may be due to immaturity. The present species comes nearest to *L. gibbosus*, Schwarz, but can be readily distinguished by its more elongate form, considerably thinner, not so convex and the posterior angles of pronotum more elongated.

Lacon subcompactus, n. sp.

Short; moderately thick; convex; dark brown in parts more or less strongly diluted with red, antennae, lateral margins of pronotum and of elytra, the posterior angles of the former and legs ferruginous; moderately densely clothed with extremely small, golden, squamose hairs. Under surface same colour as upper and similarly clothed. Head with two oblique depressions and a basal one; with rather dense, round and deep punctures. Pronotum distinctly wider than long, strongly convex but not transversely gibbose behind the middle, with an indistinct longitudinal furrow only visible on the posterior half, sides almost straight and parallel from the base to near the middle then gradually, feebly, roundly contracted to apices of anterior angles which are rounded at their extremities, sides not sinuate in front of the posterior angles, the latter almost rectangular, rather strongly depressed on the inside and with a more or less distinct lateral carina only extending a short way upwards beyond the angles; closely covered with moderately large, round, deep almost reticulate punctures. Scutellum vaguely pentagonal and almost rounded posteriorly; with small, scattered punctures. Elytra as wide as pronotum and less than twice the length of the latter, the top near the suture and a narrow margin at the sides flattened, sides almost straight and parallel from the base to beyond the middle then abruptly, roundly contracted to apex; punctate-striate, the punctures in striae not larger than those on prothorax, the interstices flat, the alternate ones elevated and with small, closely placed punctures having a granular appearance, particularly on the

basal half. Prosternum only with shallow tarsal furrows extending to the sides. Length, 9·5 mm.; width, 3·75 mm.

New South Wales: Glen Innes (C. Deane). Type, in author's collection.

A relatively wide species and conspicuous by the almost quadratic shape of its pronotum; the two oblique and the basal depressions on the head form a more or less distinct triangle, the apex of which does not quite reach the vertex of the head, and giving the appearance of having an almost round protuberance near the middle of the head. This species closely resembles the brief description given of *L. compactus*, Cand., but can be distinguished from that species by having the sides of the pronotum carinate and not at all crenulate. Up to the present I have not seen a specimen of the above species named by Candeze who, in his description wrote (referring to the pronotum) "lateribus crenulato" and again emphasizing this characteristic by writing in his comparative notes, "son prothorax fortement crénelé."

Lacon hackeri, n. sp.

Elongate; moderately thick; subopaque; dark brown diluted with red. antennae and legs a reddish-brown; rather densely clothed with short, griseous-yellow, squamose hairs. Under surface same colour as upper (except epipleurae of elytra which are reddish) and similarly clothed. Head with a large, shallow, triangular depression in the middle and two smaller ones near the top; densely covered with round, deep punctures. Pronotum about as long as wide, moderately strongly convex, posterior third gently sloping backwards, with a shallow, longitudinal, median furrow and two small round depressions on the posterior fourth, situated one on each side of the median line and midway between the latter and the lateral margin, sides rounded near the middle and on the anterior third roundly contracted to the apices of anterior angles (which are rounded at their extremities) and rather strongly sinuate in front of the posterior angles, the latter are lightly divergent, very widely and obliquely truncated and with a faintly marked carina inside the lateral margin; densely covered with rather large, round, deep punctures. Scutellum pentagonal, the posterior half much wider than the anterior, the posterior angle very obtuse and almost rounded; densely covered with moderately large, deep, subrugose punctures. Elytra at base as wide as pronotum across posterior angles and fully twice the length of the latter, sides almost straight and parallel to beyond the middle then rather abruptly, roundly contracted to apex, narrowly depressed in the middle near the suture; punctate-striate, the punctures in striae moderately large, deep and almost longitudinally rectangular, the interstices flat, densely and minutely punctured. Prosternum only with shallow, but nevertheless distinct, tarsal furrows. Length, 14·5-18·5 mm.; width, 4·5-6 mm.

Queensland: Stradbroke Island (H. Hacker). New South Wales: Sydney (A. M. Lea). Type, in Queensland Museum.

The surface of the head is very uneven, due to the large triangular depression and the two smaller ones, which are situated one on each side of the apex of the former; the pronotum appears to be longer than wide, but by measurement the width is equal to the length, the former having its widest part near the middle; the clothing on the elytra is conspicuous by being more densely arranged on each alternate interstice of the striae. A more elongate species than *L. pleureticus*, Cand., and of a duller brown, it also differs from the latter by having the posterior angles of pronotum more divergent and more widely, obliquely truncated, the surface of the pronotum evenly convex and not at all gibbose, the punctures of the latter slightly smaller and denser and the clothing, particularly on the elytra, denser and of a more squamose

appearance. It can be easily distinguished from *L. geminatus,* Cand., *inter alia,* by being more elongate, a duller brown, less nitid, the posterior angles of pronotum larger and more divergent, the pronotum more densely punctured, the interstices of the elytral striae wider and not convex, the prosternum with tarsal furrows.

Lacon castaneus, n. sp.

Elongate; convex; moderately thick; subnitid; dark castaneous with a narrow margin at the base of elytra bright red and the margins of scutellum infuscated; moderately densely clothed with very short, cineraceous, squamose hairs. Under surface same colour as upper except epipleurae of elytra which are a brighter red and moderately densely clothed with very fine and short, cineraceous, squamose hairs. Head with a large triangular depression and with densely arranged, deep, round punctures. Pronotum slightly longer than wide, evenly convex, narrowly flattened at the lateral margins, with a short, well-defined, longitudinal median furrow, sides sinuate in front of the posterior angles and then almost straight and parallel to the anterior third thence gradually, roundly contracted to apices of anterior angles which are acute and rather deeply impressed on their inside; posterior angles divergent and slightly produced backwards, acute, briefly truncated at the extremities and depressed on the inside; with moderately deep, round, not closely placed punctures. Scutellum elongate, pentagonal, concave, posterior angle obtuse, almost rounded; with a few vague punctures. Elytra as wide as pronotum across the posterior angles and slightly more than twice the length of the latter, evenly convex and very slightly flattened in the middle, sides almost straight and parallel to beyond the middle and then gradually, roundly, contracted to apex; punctate-striate, the punctures in striae much crowded, moderately large, deep and almost quadratic in shape, the interstices slightly and uniformly convex, with dense, minute punctures. Prosternum only with very shallow, almost obsolete, tarsal depressions. Length, 13·5-14 mm.; width, 4·5 mm.

North-west Australia: Roebuck Bay. Type, in South Australian Museum.

This species can be easily distinguished by its colour; its nearest congener is *L. rubiginosus,* Cand., from which it differs in being more elongate; the pronotum less convex, more deeply punctured and its lateral margins straighter; the punctures in the elytral striae are more closely placed, the interstices of same convex and more densely and deeply punctured.

Lacon multipunctatus, n. sp.

Not thick; very lightly convex, subopaque; dark brown in parts slightly diluted with red, antennae (in parts infuscated), mouth parts and legs testaceous, posterior angles of pronotum more or less reddish; moderately densely clothed with extremely short, yellowish, squamose hairs. Under surface same colour as upper, except epipleurae of elytra which are reddish, and similarly clothed. Head almost flat with a large, shallow depression in the middle and with densely arranged, very small, subrugose punctures. Pronotum barely longer than wide, very lightly convex, with an almost obsolete, median, longitudinal furrow extending the whole length, sides finely crenulate and from in front of the posterior angles almost imperceptibly curvilinearly dilated up to the anterior third and then roundly contracted to apices of anterior angles, which are acute and scarcely visibly depressed on their insides, widely and shallowly sinuate in front of the posterior angles which are slightly produced backwards, acute, very briefly obliquely truncated at apices and lightly depressed on their insides; with densely placed, small, round and deep punctures. Scutellum small, quadrangular, its lateral margins concave and

the basal one convex; closely and rugosely punctured. Elytra at base as wide as pronotum across its posterior angles and twice its length, widely flattened on top, sides almost straight and parallel to beyond the middle and then roundly contracted to apex; indistinctly punctate-striate, the punctures in striae small, round, deep and densely placed, the interstices flat and densely punctured. Prosternum only with shallow, indistinct tarsal depressions. Length, 5·5-6 mm.; width, barely 2 mm.

Northern Territory: Port Darwin (W. K. Hunt). Type, in South Australian Museum.

This species can be at once distinguished by its densely punctured upper surface, particularly on the elytra, the striae of the latter are very indistinct owing to the interstices having punctures quite as large and dense as those in the former. The shape of the scutellum also makes this species conspicuous, instead of being pentagonal, as is usual with members of this genus, it is quadrangular.

Lacon cineraceus, n. sp.

Moderately thick; convex; opaque; dull black or dark brown with parts of elytra slightly diluted with red, antennae and mouth parts testaceous, legs ferruginous; moderately densely clothed with short, griseous, squamose hairs, more densely arranged in parts and forming patches. Under surface a dark brown but slightly more diluted with red than the upper surface, uniformly densely clothed with short, griseous, squamose hairs. Head almost flat with a large, shallow, triangular depression in the middle; with densely arranged, rather deep, subrugose punctures. Pronotum barely wider than long, lightly convex, on the posterior third gently sloping towards base but not gibbose, the longitudinal median furrow only just visible on the posterior half, sides not at all sinuate in front of the posterior angles and from the latter to the anterior third straight and parallel and then abruptly, almost rectilinearly, contracted to apices of anterior angles which are acute and slightly rounded at their extremities, somewhat widely and flatly depressed inside the lateral margins, the base very lightly sinuate, the posterior angles barely perceptibly directed backwards, widely and obliquely truncated; with moderately large, rather deep, densely arranged, almost reticulate punctures. Scutellum moderately large, pentagonal, concave, obtusely angled posteriorly; the punctures more or less concealed by the clothing. Elytra as wide as the pronotum across posterior angles and about twice its length, lightly and evenly convex, sides almost straight and parallel from the base to beyond the middle and then gradually, roundly contracted to apex; punctate-striate, the punctures in striae a little larger than those on pronotum, round and deep, the interstices wide and flat with densely arranged punctures, smaller than those in the striae and more or less concealed by the clothing. Prosternum only with deep, well defined tarsal furrows. Length, 8·5-10 mm.; width, 3-4 mm.

Queensland: Bowen (A. Simson); Normanton (R. Kemp). Type, in South Australian Museum.

Very close to *L. marmoratus*, Cand., from which it can be distinguished by its darker ground colour, the prothorax less convex and not at all gibbose on the posterior half, the sides of same not crenulate and the punctures slightly larger and more densely arranged; the clothing is also different, on the present species it is much shorter and of a more squamose appearance. It differs from *L. stigmosus*, Elston, chiefly by its much finer and denser punctuation and its posterior angles of pronotum being very widely and obliquely truncated.

Lacon aquilus, n. sp.

Moderately thick; convex; subopaque, dark brown with the posterior angles of pronotum and margins of elytra diluted with red, antennae and legs reddish; moderately densely clothed with short, griseous, squamose hairs, those on the pronotum shorter than on the elytra. Under surface dark brown, in parts diluted with red and clothed with very short, griseous, squamose hairs. Head almost flat with a shallow depression in the middle; densely covered with small and deep punctures more or less concealed by the clothing. Pronotum about as wide as long, convex and slightly gibbose on the posterior half, the longitudinal median furrow barely discernible, lateral margins crenulate and from the base to the anterior third almost straight and parallel and then gradually, roundly contracted to apices of anterior angles which are acute and very slightly depressed on the inside, posterior angles rectangular, with a distinct lateral carina, the basal margin almost straight; with densely arranged, moderately large, round, deep punctures. Scutellum pentagonal, lateral margins concave, posterior angle obtuse; closely, almost rugosely, punctured. Elytra at base as wide as pronotum across posterior angles and about twice its length, convex, sides from the base gradually, almost imperceptibly, roundly dilated to beyond the middle and then roundly contracted to apex; punctate-striate, the punctures in striae moderately large, deep and elongate, the interstices flat and with closely placed punctures which are much smaller than those in the striae. Prosternum with long, deep, sharply defined tarsal furrows, metasternum with barely discernible tarsal depressions. Length, 8 mm.; width, 2·75 mm.

Northern Territory: Groote Eylandt (N. B. Tindale). Type, in South Australian Museum.

Very close to *L. ferruginous,* Cand., from which it can be distinguished by its darker colour, the punctures on pronotum not quite so crowded, the posterior angles of pronotum distinctly carinate and the punctures in the elytral striae larger. Easily distinguished from *L. labiosus,* Cand., by its larger size, the punctures in the elytral striae being proportionately much larger than those on the interstices, and the absence of tarsal furrows on the metasternum.

Lacon brevipennis, n. sp.

Subovate; not thick; subdepressed; subopaque; black with the scutellum and parts of elytra reddish, antennae and legs ferruginous; moderately densely clothed with very short, yellowish, squamose hairs. Under surface of a uniform dark brown (except epipleurae of elytra which are reddish) and clothed similarly to the upper surface. Head almost flat with the anterior margin almost straight and lightly emarginate in the middle, the mandibles are prominent and bifid at the apex; with densely arranged, rather deep, reticulate punctures. Pronotum slightly longer than wide, lightly and evenly convex, the longitudinal median furrow distinctly visible along the entire length, with two round impressions on the posterior fourth situated one on each side of the median furrow and about midway between the latter and the lateral margins, the base only lightly bisinuate, the sides from in front of the posterior angles almost imperceptibly convex up to the anterior fourth then roundly contracted to apices of anterior angles which are acute and only a little depressed on the inside, the posterior angles are almost rectangular with a well defined lateral carina, the lateral margins widely and shallowly sinuate in front of the posterior angles; with densely arranged, moderately deep, reticulate punctures. Scutellum small, almost round, convex; closely and somewhat deeply punctured. Elytra fully as wide as the pronotum across posterior angles and about one and a half times its length, lightly convex and

depressed on either side of the suture, sides almost straight and parallel to beyond the middle then gradually, roundly contracted to apex; punctate-striate, the punctures in striae closely placed, moderately large, round and deep, the interstices narrow, the alternate ones slightly elevated, the punctures closely arranged and about half the size of those in the striae. Prosternum and metasternum without tarsal furrows. Length, 8 mm.; width, 3 mm.

South Australia: Leigh's Creek (A. H. Elston). Type, in author's collection.

A very distinct insect and unlike any previously described species known to me. The red markings on the elytra are mostly in the sutural region with a few blotches near the lateral margins; the head is only very lightly impressed, the anterior and posterior angles of the pronotum are entire and not at all rounded or truncated at their apices.

Lacon rufulus, n. sp.

Moderately thick; convex; subnitid, reddish-castaneous with a narrow band at the base of elytra and a round spot on the scutellum a lighter red, antennae more or less testaceous, legs of the same colour as body; lightly clothed with short, testaceous, squamose hairs. Under surface a little darker in colour than the upper surface with the epipleurae of elytra paler; rather densely covered with very short, testaceous, squamose hairs. Head almost flat with a shallow depression in the middle; with densely arranged, deep, round punctures which are more or less concealed by the clothing. Pronotum about as long as wide, rather strongly convex and gibbose behind the middle, the longitudinal median furrow only faintly defined, the lateral margins from the base up to the anterior third almost straight and parallel (not or only barely visibly sinuate in front of the posterior angles) and then curvilinearly contracted to apices of anterior angles which are acute, rounded at their extremities and slightly impressed on the inside, posterior angles almost rectangular and slightly produced backwards, not truncated and with a barely visible prominence on the inside, the basal margin very lightly sinuate; densely covered with moderately large, deep, almost reticulate punctures. Scutellum vaguely pentagonal, narrowly depressed behind, the posterior angle obtuse and the basal margins almost rounded; with a few small punctures. Elytra as wide as pronotum across its posterior angles and less than twice the length of the former, rather widely depressed along the sutural region, the lateral margins from the base to beyond the middle almost straight and parallel and then gradually, roundly contracted to apex; punctate-striate, the punctures in striae moderately large, deep and elongately rectangular, the interstices wide and flat, with closely arranged punctures which are much smaller than those in striae. Prosternum with deep, sharply defined, curved tarsal furrows, metasternum without any tarsal impressions. Length, 11 mm.; width, 4 mm.

North-west Australia: Fortescue River, Hammersley Range (W. D. Dodd). Type, in South Australian Museum.

In shape this species somewhat resembles *L. laticollis*, Cand., but at once distinguished by its colour; the mandibles are very prominent, curved and strongly dentate on the apical third; the scutellum is a bright red with the margins somewhat widely infuscated. A much larger species than *L. ferruginous*, Cand., of a brighter colour and with the punctures on the interstices of the elytral striae proportionately smaller. It is easily distinguished from *L. badius*, Elston, by its more nitid appearance and the pronotum of an entirely different shape, on the former species the pronotum is evenly convex

with its posterior angles strongly divergent and widely rounded at their extremities, whereas on the present species the pronotum is abruptly sloping backwards on the posterior fourth and its posterior angles are almost rectangular.

Lacon punctatissimus, n. sp.

Moderately thick; convex; opaque; fuscous with the posterior angles of pronotum and parts of elytra more or less reddish, antennae testaceous, legs ferruginous with parts infuscated; rather densely clothed with short, cineraceous, squamose hairs, on parts of pronotum and elytra more densely arranged and forming patches. Under surface dark brown in parts diluted with red, the epipleurae of elytra are reddish; densely and evenly clothed with extremely short, cineraceous, squamose hairs. Head with a large, triangular, shallow depression in the middle, with densely arranged, moderately large, deep punctures. Pronotum wider than long, rather strongly convex, narrowly depressed along the lateral margins, the longitudinal median furrow almost obsolete, sides almost straight and parallel from near base to the anterior third and then abruptly, almost rectilinearly, contracted to apices of anterior angles which are acute and somewhat deeply impressed on the inside, the lateral margins barely perceptibly sinuate in front of the posterior angles which are slightly produced backwards and very widely and obliquely truncated, with a small protuberance on the inside and a more or less distinct lateral carina; with densely arranged, moderately large, deep, round punctures. Scutellum pentagonal, concave, anterior angles right-angled, the posterior one acute, with a few punctures which are concealed by the clothing. Elytra at base barely wider than across posterior angles of pronotum and a little more than twice the length of the latter, evenly convex, sides slightly dilated near the middle then gradually and roundly contracted to apex; punctate-striate, the punctures in striae large, deep and crowded, the interstices are narrow with densely placed, deep, round punctures, smaller than those in striae. The prosternum has well defined tarsal furrows, those on the metasternum barely discernible. Length, 8-9 mm.; width, 3-3·5 mm.

Northern Territory: Groote Eylandt (N. B. Tindale). Type, in South Australian Museum.

The reddish parts on the elytra form spots, which are more densely covered with the greyish squamose hairs, giving the insect a mottled appearance; the pronotum, although somewhat strongly convex, is not conspicuously gibbose behind the middle and the surface when viewed from the side appears very uneven, this is due to shallow, round depressions near the middle, these, however, are scarcely visible when viewing the insect from above; the basal half of the elytra is more strongly punctured than the posterior half which gives the former a granulated appearance. Near *L. marmoratus*, Cand., but with the pronotum less convex and with the gibbosity behind the middle not so pronounced, the chief distinction is the different sculpture of the elytra, in the present species the punctures in the elytral striae are much larger, the interstices are narrower and with larger punctures, particularly on the basal part which has a strong granulated appearance. It can be easily distinguished from *L. cineraceus*, Elston, by the much stronger punctuation of the elytra and with the interstices of the elytral striae narrower.

OBSERVATIONS ON THE SOUTH AUSTRALIAN MEMBERS OF THE SUBGENUS, "WALLABIA."

By Hedley Herbert Finlayson,
Hon. Associate in Mammalia, South Australian Museum.

[Read October 13, 1927.]

Plates XVI. to XVIII.

Introduction.

The genus *Macropus* (Shaw), in spite of its immense geographic range, exhibits very little structural variation. The subdivision of its twenty-three species, which has been generally accepted, is that introduced by Oldfield, Thomas (1) in 1888, who made bodily size the chief criterion of eligibility in three groups known respectively as Kangaroos, Large Wallabies, and Small Wallabies. Bodily size was defined chiefly by reference to the length of the pes and the basal length of the skull, and a member of the genus was said to be a kangaroo when the length of its foot exceeded 260 mm. and the basal length of its skull 135 mm.; a large wallaby when these measurements fell between 160-250 mm. and 108-130 mm. respectively; and a small wallaby when the foot was less than 160 mm. and the skull 108 mm. long.

This classification is rendered less arbitrary and given some systematic sanction by the fact that bodily size is correlated, to some extent, not only with certain cranial and dental characters, although these are of a minor kind, but also with habits and distribution, and the three groups of Thomas have been replaced in recent usage by three co-extensive subgenera, *Macropus* s.s., *Wallabia*, and *Thylogale*.

The cleavage between *Macropus* s.s. and the smaller species is, on the whole, more definite than between *Wallabia* and *Thylogale*, and the status of one or two species of these last may need revision when the examination of large series and, particularly, the extension of field observations, permit of more precision in the statement of average specific characters.

The great variation in adult size of many of the Macropods is well known to those who have made many measurements of specimens in the flesh, and aged males of both sections of wallabies frequently transgress the limits of the subgenera as stated above.

In addition to the characters mentioned the species of *Wallabia* are further distinguished both from *Macropus* and *Thylogale* by the relatively greater length of the tail, the distal portion of which is commonly clothed by hairs which are longer and more loosely applied, and by the greater richness and variety of their ornamentation. Eight well-defined species, separated both by external and cranial characters, constitute the group, and many varieties have been described. Of these, eleven subspecific forms are allowed by Cabrera (2), but it is probable that the examination of larger series, with due consideration of seasonal changes in pelage, will result in a further reduction in their number.

Six of the species are confined to the Australian mainland, one occurs also in several islands of the north coast and in New Guinea, and, the last to be described, the remarkable *M. wellsbyi* of Longman (3) appears to be an exclusively insular form.

The geographical range of the group is a wide one, and embraces areas of widely different character as regards topography, vegetation, and climate; but it

is noteworthy that none of the species have succeeded in adapting themselves to arid conditions, and most of them show marked preference for well-timbered districts of high rainfall. Their occurrence may therefore be said, in a general sense, to be coastal rather than inland, and the chief gap in its continuity exists on the south coast, between the meridians 120° and 135° E., where the Nullarbor Plain and the adjacent drylands, east and west, extend right to the seaboard.

In South Australia two members of the subgenus, *M. ruficollis typicus* and *M. greyi* have long been known to exist, and a third, *M. ualabatus (W. bicolor)*, has recently been claimed as a member of the fauna of the State by Professor Wood Jones (4), although the evidence in support of its status as an indigine is slight.

The literature relating to these South Australian wallabies is very scanty, and since the observations of Gould (5) on *M. greyi* and the bare record of the occurrence of *M. ruficollis typicus*, by Zietz (6), nothing appears to have been published in regard to them till the appearance in 1924 of F. Wood Jones' "Mammals of South Australia." In this last, for reasons connected with the scope and purpose of the book, their treatment was necessarily brief, and much remains to be done in the way of defining their local distribution, their present position in the fauna, and recording such details of their habits and natural economy as can be gleaned.

The need for so doing is increased by the fact that *M. greyi* is almost exclusively South Australian in occurrence, has many peculiar characters which render it very distinct, and is at present on the very verge of extinction, while in the case of *M. ruficollis typicus* the South Australian animal is the extreme westerly representative of a species which has been studied from eastern material only, and which, although still well established elsewhere, is here greatly reduced in numbers, and until recently was unrepresented in the State Museum.

Apart from the rapid disappearance of the animals themselves, another factor which lends urgency to the need for a more complete record is the equally rapid passing of the generation of men who knew them in the day of their plenty and whose circumstances in the early days of the colony brought them intimately in contact with the fauna under conditions which were very favourable for observation. Indeed, the purpose of the writer is as much to make public the impressions and opinions of these pioneers, as to record the somewhat meagre results which accrue from observations to-day, under circumstances which the advance of settlement has made comparatively adverse.

In South Australia the subgenus occupies but a small fraction of the total area of the State, and to that extent it is not an important element in its fauna.

At the time of the first settlement of the colony it is probable that its range was constituted by all that portion of the State which lies east of the 139th meridian and south of the 35th parallel, but its distribution throughout this tract was not uniform, and showed, rather, an increasing density from north to south and, probably, also a considerable hiatus in the mallee country of its north-eastern corner.

Both species appeared to have crossed the Murray, but the extent of their tenure of the river flats is difficult to estimate, and from this north-western part of their range they were early driven, or greatly reduced, by the rapid advance of closer settlement. Their former presence in the lower part of the county of Sturt is vouched for by many residents of that part of the country still living, but I have been unable to gather any reliable evidence of their occupation of any part of the Mount Lofty range system. A small wallaby, probably the mainland *M. eugenii* (now extinct), was well known in the hill country, but this species, together with the black-faced kangaroo, *M. giganteus*, var. *melanops*, seem to have been the only members of the genus in the highlands south of the 35th parallel. In the case of *M. greyi*, this failure to occupy the hill country might be antici-

pated from what is known of its habits, but with *M. ruficollis* it is somewhat remarkable, as the same species in eastern Australia is to be found well established in rugged mountainous country, where the climate is much more rigorous and conditions of forage far less attractive than in many parts of the Mount Lofty range.

With the exception caused by the vacation of Trans-Murray district, the range of the subgenus in South Australia remains much as before, but throughout the whole its members have been greatly reduced, and over large areas have disappeared altogether.

The tract of country defined above is made up of the whole of the South-eastern Division of the State, plus the south-western portion of the Murray Mallee Division, and, judged by its topography and vegetation, may be divided into an upper and lower district. The upper district forms part of what has come to be known as the Ninety-mile Desert, and, with a few inconsiderable oases, is characterised by a uniform sandy soil and an undulating surface which rises at frequent intervals to form sharp ridges, sometimes of exposed limestone, more frequently of sand. Between the ridges are long trough-like depressions or flats, and occasional claypans in the latter provide the site for the infrequent surface waters of the area. The ridges are commonly bare or, at most, sparsely clothed with dwarf banksias and casuarinas, but the flats and gullies are rather densely covered by very stunted mallee. Although not without a certain grim attraction, the general aspect of the country is in keeping with its name, and, in spite of the fact that the mallee is not altogether destitute of undergrowth and the rainfall is nowhere less than 15 inches, its grazing value is low, and it remains the most sparsely settled area south of Adelaide.

The absence of any abrupt transition renders it difficult to set a southern limit to this type of country, but the counties of MacDonnell, Robe, and Grey may be said to constitute a second lower district which, on the whole, is in marked contrast to the upper. This is a notably flat, low-lying area with a rainfall increasing from 20 inches in the north to over 30 inches in the extreme south, and it affords far greater variation in the types of its soils and vegetation than the upper. These variations are most noticeable when the country is traversed from east to west, and it may be said to consist of comparatively narrow strips of rich loams or silts rapidly alternating with poor sands, and in the south the former merge with the wider areas of volcanic soils about Mount Gambier and Millicent.

Both types of country were, originally, well timbered, but with quite distinct species, the sandy stretches supporting the rough-barked *E. viminalis* (locally called a stringy-bark), in belts or clumps which are isolated from one another by open heaths of small xanthonheas, leptospermums, and banksias *(B. ornata)*, while the richer country is more densely and uniformly clothed by smooth-barked eucalypts (chiefly *E. rostrata* and *E. leucoxylon)*, together with the large *Banksia marginata* or honeysuckle. Here the undergrowth is practically absent, being replaced by grasses, and in encouraging the growth of the latter by felling the timber the face of the country, in certain parts of the district, has been completely changed during the period of settlement.

In the sandy country the surface is frequently elevated to form low ridges, usually running north and south, and these are densely timbered and clothed also with a thick undergrowth of bracken *(Pteridium* sp.), interspersed with the smaller species of the surrounding heath. These ridges are locally dignified by the name of "ranges," but few of them are high enough to break the flat montony of a general view. The coastal belt is distinct from either of these two main types of country and for many miles is backed by low ranges, of which the Woakwine and Black Ranges are the most considerable. On the more northerly of these hills the mallee, characteristic of the desert, reappears, but, in general, eucalypts

are less in evidence here than melalucas, and in many places on the eastern slopes acacias and melalucas, either singly or in combination, form dense tangled thickets of a kind not represented further inland.

Although destitute of permanent streams, the whole of the lower district is particularly well favoured with subterranean water supplies, which are tapped, in most localities, with the greatest ease and which supply permanent waterholes, both artificial and natural, scattered liberally over the whole face of the country. In this respect the lower district contrasts strongly with the upper in which surface waters are both few and fugitive, and the contrast is heightened when in winter, from causes not entirely dependent on the local rainfall, great areas of low-lying country are converted into swamps.

From the faunal point of view the lower district is of far greater importance than the upper, and the combination of rich, well-watered grasslands, flanked everywhere by the scrubby "ranges" and wide heaths, with its consequent attractions of easy forage and shelter, has in the past supported a marsupial population which in variety and density is equalled by few other areas in Australia.

PART I.

MACROPUS (WALLABIA) GREYI. (Gray, 1843.)

History.—This wallaby appears to have been first brought under notice by Sir George Grey, who, while Governor of the colony, presented skins and skulls of a male and female to the British Museum. These specimens were listed in 1843 by J. E. Gray (7) and the species named in honour of the donor, but the first extended description is that of Waterhouse (8) in 1846. Gould collected the animal in the south-east of South Australia, and in 1863 (5) published some account of its habits and figured it in two beautifully-coloured plates. In 1888 Oldfield Thomas (1) redescribed the species and drew attention to the cranial characters which distinguish it from its associates in the subgenus. Wood Jones (9) in 1925 described the hair-tracts of the pouch-young, and redescribed (4) the external characters of the adult from material in the South Australian Museum, giving at the same time some measurements of the skulls available, and brief notes on its natural history. In addition to these major contributions, the species is mentioned in several lists and compilations such as those of Krefft, Zietz, and Lyddeker, without, however, anything being added to what was already known.

Although the descriptions of Waterhouse, O. Thomas, and Wood Jones have embraced most of the external characters of the species, the examination of fresh material acquired by the South Australian Museum, the examination and photographing of a living example on several occasions, and, more particularly, the weighing and sifting of information gathered during seven years from residents of long standing in the South-eastern District, enables the writer to confirm much that has been written, and to add a little to these previous accounts.

Distribution in the past, and present position in the Fauna.—The former range of *M. greyi* in South Australia [1] was approximately that of the subgenus as defined above, but the extent of its occurrence northwards is difficult to ascertain, owing partly to the confusion which is introduced by the application of different popular names to the same species in different districts; thus, whereas in the lower district and in the "desert" the present species was invariably known as "Toolach",[2] across the Murray this name was given also to a much smaller

[1] The species was not exclusively confined to South Australia, but occurred also through a small strip of Victorian territory contiguous to the border.

[2] Although presumably aboriginal in origin, I have been unable to obtain reliable information as to the etymology of this word; the spelling adopted here is that of Wood Jones, but it may be noted that, by the majority of settlers, the word is pronounced Toe-lait-shee, with the accent on the second syllable.

wallaby than *M. greyi,* probably the mainland form of *M. eugenii.* Nevertheless, the striking characters of the Toolach early attracted the attention of the settlers, and the fact of its inhabiting relatively "open" country easily accessible from, and indeed often contiguous to, the settled areas, has made it one of the best known native animals throughout its habitat. It can scarcely be said that the memories of the "Old Timers" have yielded up a wealth of information regarding it, but there is an approach to unanimity in the main features of their accounts which is conspicuously absent from the impressions left by many other more obscurely living species.

The Toolach was essentially a clear-country wallaby, avoiding both heavy timber and thick scrub, and in all parts of its range showed a marked partiality for grass country, not simply as a feeding-ground, but as a "beat" in which practically the whole time of the animal, both feeding and resting, was spent. In the typical desert country of the counties of Russell and Buccleuch, where grass flats are few and far between, it occurred but sparsely, and here appeared to be comparatively solitary, but in the lower south-east, where richer soils permit a far greater development of grasses, its undoubted instinct towards gregariousness asserted itself, and when the country was first settled it was here established in a series of isolated colonies, moderately well delimited and very frequently situated on what is known locally as the "fringe" or "Black Rush" country (pl. xvi., fig. 1). This may be described as a transition belt between the light sandy soils and the richer loams and clays; between the stringy-bark and heath, on the one hand, and the smooth-barked gum and grass country on the other. Flat, or at most gently undulating, these areas become swampy in winter, and the depressions are filled by a low matted growth of small rush *(Lepidosperma laterale)* which earns for the locality one of its local names. Alternating with the rush are patches of tall, coarse grasses, the most conspicuous of which are *Poa caespitosa* and the so-called kangaroo grass, *Themeda triandra.* There is little big timber, but honeysuckle *(Banksia marginata)* occurs both singly and in little groves, and there are frequent clumps of dwarf *Xanthorrhea* and the little *Banksia ornata.* Although "fringe" country is very extensive in the district, the whole of it was not occupied by Toolaches, the groups of which showed marked partiality for certain quite restricted areas, from which they were only driven by persistent persecution, and to which they returned again and again. In spite of many changes caused by closer settlement of the country, the sites of many of these Toolach colonies are still well remembered, though the wallaby itself has long gone.

It has been stated that the Toolach was at one time exceedingly numerous and, for instance, "swarmed in the neighbourhood of Kingston" (4), but in accepting these statements it is necessary to bear in mind that they apply to relatively small areas only, and a considerable weight of evidence inclines me to the belief that in point of numbers *M. greyi* fell far short of the four other species of *Macropus* in the district. Although human persecution and the occupation of its chosen country early reduced its numbers and broke up and dispersed its larger colonies, it was still far from uncommon even as late as 1910, and scattered bands were still to be found in suitable localities. The chief of these were along the edges of the long strip of grass country extending from a little north of Millicent to the vicinity of Bull Island and Reedy Creek, and known locally as the Avenue Valley, on the Biscuit Flat between Robe and Kingston, the Mosquito Plain between Naracoorte and Penola, and in the country between Clay Wells and Conmurra, and probably also in the sandhill country of its northern district. Its rapid disappearance in the last twenty years may be attributed with some confidence to the invasion and enormous increase of the English fox, which has been proved without doubt to take a heavy toll of the young, even of the large kangaroos, and indeed in the almost unoccupied desert country where man has had little influence on its

destinies, it seems that the fox has been the sole factor in effecting its extermination. Its chief natural enemies before the advent of the white man and the fox seems to have been the wedge-tailed eagle *(Uroaetus audax)*, which, like the latter, chiefly attacked the young. These attacks were by no means always successful, and were sometimes thwarted by the courage of the females. Mr. Andrew Robson, of Robe, on whose property of "Comung" the species was once well established, relates that he once witnessed such an attack, in which the eagle, flying very low, persistently followed a female with a large joey. The bird manoeuvred continually with the patent intention of keeping the two separate, and the whole energies of the doe were equally obviously bent on preventing this separation, but her task was rendered difficult by the frequent panic-stricken rushes and bewildered halts of the joey. Matters continued thus for several minutes when one such rush brought the latter within striking distance; but as the bird dropped to 3 feet to seize him the doe sprang at the attacker, and with both hind feet struck the peculiar slashing blow common to most of the macropods. Whether the blow went home or not the observer was not able to see, but the sally was sufficiently diconcerting to cause the wedge-tail to beat a retreat, during which the joey regained the doe's pouch and with it safety.

The outcome of these encounters was not usually so satisfactory (to present-day sentiments), and I learn from another source that small boys in a certain district were in the habit of periodically visiting the sites of eagles' nests to recover the scalps from the remains of young Toolaches to be found lying underneath; this at a time when a bonus of sixpence was paid on all marsupial scalps.

By 1923 the species had become exceedingly rare. Isolated pairs were no doubt scattered through the rougher stringy-bark country, but the sole remnant of the Toolach population which continued living in country and under circumstances which might be regarded as typical of that formerly obtaining, was a small band of perhaps fourteen individuals, located on the south end of Konetta sheep run, some twenty-six miles south-east of Robe.

Public attention was first called to the rapidly approaching extinction of the Toolach by Professor Wood Jones, who repeatedly stressed the urgent need for rigid protection of this group at Konetta. In May, 1923, as there appeared little prospect of effective conservation in the south-east, an organised attempt was made on a considerable scale to capture living specimens for transference to the sanctuary on Kangaroo Island. This, and a later attempt in 1924, failed in their main objective, since as a result of overmuch driving the four examples obtained were either dead or died shortly after capture, but were not altogether fruitless, as much-needed Museum material was thus acquired.

The subsequent history of the species consists of a resumption of the exterminating process. Owing to the extensive publicity given to the two expeditions noted above, local attention was focussed on the Toolach to a degree hitherto unknown. Much of this attention was undoubtedly sympathetic to the idea of conservation, but the realization of the great rarity of the wallaby roused the cupidity of an unscrupulous few, and that survivors of the 1924 attempt have been wantonly killed for the sake of the pelt as a trophy, is an assertion based on the admission of at least one of the slayers. The constant hunting of foxes with dogs over the Toolach country has been made the excuse for some of this killing, the plea being advanced that it is impossible to prevent the dogs running anything and everything that is put up. The pretext is a flimsy one, however, and not only is there an obvious expedient in avoiding the locality altogether, but interrogation usually elicits the fact that "nothing spoils a dog like checking him." This peculiar solicitude for the dog's training has borne very heavily on the Toolach and still bears very heavily on his cousin the brusher. Occasionally, however, a better spirit prevails, and recently a Toolach doe was promptly rescued from two

kangaroo dogs which had seized her, and, in the patient care of Mr. J. Brown, of Robe, she has survived the rough handling received. She may well represent the last of her race in this State, as a careful and extended examination of the beat of the Konetta band by the writer in February of this year failed to reveal any recent traces, either in the shape of tracks or dejecta, and the opinion is expressed by the resident who knows the country best that the band has been entirely extirpated.

The species is very poorly represented in Museums, and enquiries recently instituted in all the States indicate that there are six skins and seven skulls in the public collections of Australia; of these, four skins and five skulls are preserved in the South Australian Museum.

Habits.—Apart from the semi-gregariousness mentioned in discussing its local distribution, in the main features of its habits relating to such routine matters as feeding, lying up, and breeding, *M. greyi* appears to have offered little of contrast with the other members of the genus. On the other hand, in many of its physical attributes the species is markedly distinct from all others in eastern Australia, and, as already mentioned, this fact has been instrumental in creating unusually clear impressions regarding it. Three attributes have chiefly served to create this impression—its speed, its gait, and the elegance of its form and bearing and ornamentation.

The speed of the Toolach is a matter which has become almost traditional in the districts which it formerly inhabited, and the regular coursing of the wallaby with dogs has provided the material for a rich fund of anecdote. That it was by far the swiftest of all the native animals in the district is the universal testimony of those who have coursed it, but the attempt to set up a standard of comparison by means of which its speed may be more strictly defined is a matter of difficulty owing to the variety and heterogeneous breeding of the dogs used in its chase.

After sifting the evidence from a great many independent sources, it may be accepted that in open grass country, on firm, dry soil, and with a close-up start, the chances were somewhat heavily against a Toolach holding its own with a greyhound, and a somewhat sticky soil confers a further advantage on the latter. This is not to say, however, that such runs, even under these conditions (when the dog is prepared and the wallaby probably not), were always fatal to the wallaby. There appear to have been Toolachs of exceptional pace, and probably in this species, as in most others of the genus, there was a marked sexual difference in this regard, the adult female being considerably slimmer, more lightly built, and fleeter than the male at a comparable stage of growth. In making these comparisons it is well to bear in mind also that the greyhound is exceeded in speed by very few of the monodelphian cursorial mammals. It is a somewhat striking attribute to the possibilities of the saltatory mode of progression, and a tribute which may be sufficient to acquit that mode of any inherent inferiority, that the little Toolach is able on occasion to hold its own with a breed of dog which has recently been shown to be capable, for short sprints, of the enormous speed of 42 miles per hour. The slight advantage in speed which the greyhound possessed in an open unobstructed run was to a large extent lost when the Toolach succeeded in gaining one of the belts of low scrub and tussocks which fringe the grass country. Here progress is only effected by frequent and abrupt changes of direction, and in avoiding obstacles at speed the bipedal, higher-jumping wallaby was far more adroit than the dog, and the escape of the former under these circumstances seems to have been regarded almost as a foregone conclusion.

Even more striking than its fleetness was the staying power of the Toolach and its ability to maintain a high speed over relatively long distances. This is a character which is not shared by many of the macropods. Of the larger kangaroos *M. rufus,* and, to a lesser extent, *M. giganteus,* are accustomed to covering great distances in moving from one feeding ground to another, and their tireless

endurance when allowed to adhere to a certain chosen and apparently almost effortless stride has excited the admiration of many observers. Further, the kangaroos, and some of the larger wallabies, under the influence of fright or the pain of a minor wound, are capable of amazing bursts of speed for short distances, but the respiratory apparatus of most species seems to be ill adapted to meet the strain of such effort for more than a few hundred yards, and a very noticeable and even abrupt slowing down then takes place. This fact is well known to kangarooers throughout the mallee, and in hunting the black-faced kangaroo with dogs it is during the ensuing period of partial but temporary exhaustion that most dogs of mixed breed make their kills; if the dog fails to close at this stage, a long chase ensues, in which (if he refrains from "sticking-up" to fight) the odds steadily increase in favour of the kangaroo.

The capabilities of *M. greyi*, however, seem to have been in a different category, and when flushed it almost at once attained a speed sufficiently great to extend the best of dogs, but this speed it continued to increase over a considerable distance, and even with greyhounds very long runs were the rule rather than the exception. Its endurance was strikingly illustrated during the ill-fated attempt to obtain living specimens at Konetta in 1923, and Mr. Edgar R. Waite, who was present, informs me that at one stage a pair was chased by a band of horsemen over the entire length of the paddock; they then turned short, retraced their course, with the pursuers still following, and finally, after a four-mile run, jumped a fence and passed within a short distance of their original starting point, with "speed apparently undiminished."

In the character of its stride, which is very long and low, and made with the greater part of its body extended in an almost horizontal direction, it was readily distinguished from *M. ruficollis*, which species, although usually frequenting a very different type of country, appears occasionally to have associated with *M. greyi*. In addition to this peculiarity of the individual leaps, however, it could be at once recognised also by certain features in its gait which are usually summed up in the statement that "it took two short hops and then a long one,"(3) though less frequently the alternative "two long hops and a short one" is substituted. This impression of some irregularity in its progression has been so generally received by settlers in all parts of the district that there seems no doubt that it rests on a substratum of fact. The matter is not so simple, however, as is implied in the above statement, and to the obvious enquiry as to whether the two short hops were followed by a long one constantly, under all conditions, at all speeds, and over both open and unobstructed ground, I have received somewhat unsatisfactory and widely different answers. A minority of those questioned on the matter (and these not the least entitled by experience to credence) are of the opinion that any irregularity of the kind indicated was noticeable only when the Toolach was hotly pursued on rough ground; the long hop, according to these observers, did not recur at regular intervals, but was made only occasionally, and then at a sharp angle to the former line of flight. On this view it represented only a sudden change of direction either to avoid some obstacle or to embarrass the pursuer, a trick which is practised by all the kangaroos and wallabies to a greater or less extent, and in which the so-called "native hare" *(Lagorchestes leporoides)* has acquired an almost uncanny proficiency.

On the few occasions when the writer has been able to observe Toolaches under natural conditions, the observations were made at some distance and in country where the height of the undergrowth prevented any clear impression being received, and the single example which has been examined in captivity,

(3) This statement is commonly modified by the settlers, who prefer to say that it took "two long hops and then a much longer one"; in this form, and embellished with suitable adjectives, it is a long-established joke in the Toolach country.

although almost constantly on the move, throws little light on the matter owing to the short distance which she has to traverse.

If it be true that the species did actually progress, either at all times, or under special circumstances only, by leaps which were of unequal length, but of definite sequence, it would appear to have possessed a trait unique among the Macropodidae and rich in speculative interest.

In discussing the saltatory habit of some of the small marsupials of Central Australia, Sir Baldwin Spencer (10) has suggested that an animal which proceeds by leaps and bounds may be less easily struck down by a bird of prey than one which progresses cursorially, and in view of the fact that the rapidly alternating movements in a vertical plane are greater in the case of an animal which hops than in the case of an animal which runs, this supposition would appear to be well founded. The plentiful occurrence and aggressive habits of the wedge-tailed eagle, in the habitat of the Toolach, has already been noted, and it seems not unreasonable to assume that the gait of the latter may have been acquired for the purpose of further increasing the difficulties of an attack from the air by adding an element of irregularity to the already undulatory character of its advance.

External Characters.—The early settlers were ill-disposed to see beauty in any of the native animals, but a partial exception was made of the Toolach, which is very generally spoken of with some approach to admiration, even by those who have played a leading part in its destruction. In a group which comprises several handsome animals it is a matter of difficulty, and one determined largely by individual taste, to assign pride of place to any one of them; still, it would be generally conceded that of the species which are sufficiently well established to be familiar, two are conspicuously well favoured—*M. parryi,* of the east, the claims of which to distinction rest largely on the elegance of its form; and *M. irma,* of the west, which is unrivalled in the striking yet harmonious character of its ornamentation, and, in considering the place of the Toolach, it may justly be said to share and blend many of the beauties of each.

The examination of Museum material, although it may suffice for the determination of gross external characters, conveys in the present case but a very inadequate impression of the animal in nature, and of the finer details of its general appearance and bearing, and for opportunities of observing these matters I am greatly indebted to Mr. J. Brown, of Robe, who, as already noted, possesses the only example of the species in captivity at the present time. This specimen is a female, apparently adult, and when captured was observed to have a large pouch young, which, however, most unfortunately she has failed to rear. At the time of my visit she was still exceedingly nervous and timid, and difficult to approach; but this, although adding greatly to the difficulties of photography, was no bar to observation, as the enclosure was small. In spite of this nervousness and agitation, she gives ample evidence of the intense curiosity which is so marked a feature in all the Macropodidae; her flights from the human intruder are of short duration, and if one remains quiet, are followed by periods when there is an obvious and amusing struggle between curiosity and fear, which adds not a little to the pleasure and interest of observation. In size this example is quite equal to the average adult female of *M. ruficollis typicus,* found in the same district, but the two species form a marked and interesting contrast in build and deportment. The Toolach is an exceedingly lithe and graceful wallaby, and all its movements are made with a delicate precision somewhat reminiscent of the rock wallabies. It is built on fine long lines, lending an air of slimness to its appearance, which is heightened by its erect carriage, and although the hind limbs are strongly developed and the fore limbs greatly reduced, there is less disproportion between the abdominal and thoracic portions of the trunk than commonly obtains, and which is so remarkable in the females of the kangaroos. The head is set on a

relatively long neck, and in its general relation to the shoulders as well as in certain intrinsic qualities is suggestive of *M. rufus*. It at once attracts attention on account of the very bold, sharply-defined cheek stripes (pl. xvi., fig. 2), the long, rufous-backed, pricked ears (which are less mobile than in many wallabies, and which are noticeably notched towards the extremity on the posterior margin), and the peculiar shape of the muzzle. This last is long, parallel-sided, and very deep from above downward, and it terminates somewhat bluntly in a large, naked, black rhinarium, the area of which is made to appear greater than it is by a half-inch wide border of black fur separating it from the light grey of the face, and by the circumstance that the median portion of the upper lip is also black. This departure from the somewhat rapidly tapering conical muzzle general in *Wallabia* and *Thylogale* confers a peculiar character on the physiognomy of the species which may be crudely expressed by saying that in a front view it appears always to be "looking down its nose."

The fore limb, as compared with that of *M. ruficollis, M. ualabatus, M. parryi,* and *M. agilis,* is short and feeble, and the manus is very small indeed; in that respect, and also in the shortness of the digits and the great relative breadth of the palm, it is very similar to that of *M. irma*. The small size of the forearm is disguised to some extent by its being clothed by fluffy, almost upright hairs, which are a glistening yellowish-white in colour, 25-30 mm. long, and sharply contrasted with the short grey fur of the proximal part of the limb and shoulder. At the carpus the long upright hairs are replaced abruptly by short yellow ones which, being closely adpressed, give the appearance of a sudden constriction at the wrist and contribute to the appearance of diminutiveness of the hand. This condition at once attracts attention in the living animal, and although it is very apparent also in all four filled skins which have been examined, appears not to have been previously described.

When moving at some speed its arms are pressed closely to its sides and chest, and the hands are then necessarily approximated; but apart from this, whenever it assumes the upright position, and, in fact, under almost all circumstances when not actually in use, the hands are brought forward away from the body and are held together, sometimes with the palm of one resting on the back of the other, but more usually with both palms together and the digits partially interlocking (pl. xvi., fig. 2).

The hind limb is large, but in the relative length of the femur and tibia (1: 1·48) it shows no departure from the proportion existing in other large wallabies. Those who have closely examined and skinned many Toolaches assure me, however, that the shape of the foot was distinct from that of *M. ruficollis* (the natural standard of comparison in the district) in that it was bowed outward somewhat between heel and toes. I have not been able to observe this in the example under consideration and examination of the metatarsi of two part skeletons, and of the pes in filled skins, gives no indication of any such condition. The pes and its digits are slender and delicate, and the fifth toe is relatively long. The nail of the fourth toe is also conspicuously long, as noted by Gould and O. Thomas, but the statement of the former (5) that it exceeds in length that of all other wallabies is more generally correct when applied to *M. agilis;* the length of the central nail, however, is very inconstant, and subject to considerable variation in all species. The granular sole of the pes is continuous from the heel to the extremity of the fourth digit, but its width is not nearly uniform throughout its length as in other large wallabies, but is suddenly constricted to one-third of its breadth at a point about one-third of the total length from the heel, and it continues thus constricted for about an equal interval, widening again suddenly as it approaches the main interdigital pad. The condition is reminiscent of that obtaining in *M. rufus* and *M. giganteus,* except that the encroaching of the hair

from the sides of the pes is never sufficient to interrupt the continuity of the sole. The white thigh stripe is quite noticeable in the living animal (pl. xvii., fig. 1), but does not contrast as strongly with its background of light grey as in *M. agilis* and *M. dorsalis*.

The tail is but moderately long, rather thin, evenly tapering, and, for the greater part of its length, circular in section. Its most noteworthy feature is the conspicuous crest of long white hairs, which is erected from the dorsal surface of its distal third (pl. xvii., fig. 2). This crest has been little emphasised in previous descriptions. It is not mentioned by Gould, nor Wood Jones; Thomas (1) states that "indistinct upper and lower crests of white hairs developed on its distal half," and Waterhouse (8) states specifically that *M. greyi* "may be distinguished from *H. manicatus* by its having no crests to the apical portion of the tail." These discrepancies and partial oversights are probably due to the fact that once the skin is separated from the underlying muscles, the crest subsides to a considerable extent, and is thus less prominent in a filled skin than in life, and in a flat skin is easily overlooked. There may be, and probably are, variations in its relative development, but it is sufficiently constant to have attracted the attention of the early settlers, and is evident in all four skins in the South Australian Museum.

The exact condition of the pelage of the tail as it exists in the filled skin of an adult female (South Austr. Mus., Reg. No. M2121) is as follows:—The hairs on the dorsal surface of the base of the tail are very long (45-50 mm.), grey-fawn at the base, ashy-grey terminally and loosely packed. There is no sudden transition from body hairs to specialized tail hairs, as is usual in *Macropus*, but proceeding distally there is a gradual increase in coarseness and degree of adpression till a point about 150 mm. from the base is reached, from which its texture remains unchanged to the tip, but throughout the whole of its length the degree of adpression is less than in other wallabies of the group. At or about the 150 mm. point also, the superficial ashy-grey becomes more fawn, but from here, distally, the basal portion of all the hairs is dark brown or black. From the mid-point of the dorsal surface the hairs lengthen so gradually that it is difficult to define the length of the crest, but the erection of the hairs above the general surface of the tail becomes obvious 150 mm. from the tip, and for the terminal 50 mm. the hairs are 40 mm. long, uniform pale yellowish-white in colour and considerably elevated. The hairs of the ventral and lateral surfaces are generally short and stiff as in other species, but there is a distinct lengthening for the terminal 50 mm., which, however, is not accompanied by any considerable elevation, and which, therefore, does not result in a brush or tuft, as in *Petrogale*, nor in a second ventral crest as in *M. irma*.

The tail is very flexible and capable of greater and more varied movement than in other members of the genus that I have observed at close quarters, and when the animal is apprehensive, the terminal third is sometimes lifted just clear of the ground and is rapidly flicked from side to side, in the manner of an angry cat. Even during the course of its immense leaps and when still in mid-air this flexibility seems to be in part retained, and in place of being held rigid and strongly convex to the ground surface, it remains almost straight, and has the appearance of streaming out behind (pl. xvii., fig. 1). The same characteristic is noticeable in the tails of the *Petrogale*.

One of the most interesting and curious of its external characters is the transverse banding of the dorso-lumbar region, and this is also one of the many characters which it shares with *M. irma*, and it is somewhat remarkable that in neither case were the bands noticed, or at least commented on, by the original describer. It is true that they are somewhat obscured in flat skins, and that their visibility varies with the position of the observer, but they are unmistakably present in all skins of both species which I have examined, and this in the winter as well

as in the summer pelage. Gilbert (11), whose observation was generally both keen and accurate, and who was well acquainted with the western species in its native habitat, gives no indication of being aware of the banding in his notes on *M. irma* in 1844. In the case of *M. irma* the omission was made good by Krefft (12) in 1871, and, in the case of *M. greyi*, by Wood Jones (4) in 1924. In the living animal the banding of the back is very prominent, and at once attracts attention, but the exact condition existing I have not been able to ascertain owing to the difficulties of a close approach.

In the filled skins in the South Australian Museum there is a substantial, though not absolute agreement, in the main features of the banding, and the description of the example in which they are most marked is applicable, with very slight modification, to them all. In this skin (that of an adult female, Reg. No. M2121) twelve bands of alternate light and dark-grey are visible in a posterior view, arising, as stated by Wood Jones, slightly anterior to the costal margin and continuing to the base of the tail. Of the series, six in the anterior lumbar region are much better defined than the remainder, and here the light bands are twice as wide as the dark. Their visibility varies greatly with the incidence of the light, and they are at all times plainest when the illumination is diffused or even dull. The banding seems to be produced chiefly by an alternating difference in the length of the fur, the light bands corresponding to areas of long hairs, the dark bands to areas of short hairs, and in certain lights the presence in the general surface of the coat of these elevations and depressions causes a shadow effect in the latter. In addition to this, however, the black-tipped hairs which are present over the whole of the dorsal surface show a tendency to concentrate in the narrow valleys. The invasion of the lateral surface by the bands is nowhere very considerable, but is greatest in the anterior portion of the series; those at the hinder end approaching the tail are the shortest, and are not visible in a side view. The unilateral slip in the pattern, which has been emphasised by Wood Jones (4) as of frequent occurrence in banded marsupials of several families, is not here apparent, but it may be pointed out that the bands are not strictly transverse to the long axis of the trunk through the whole of their length, but approach the dorsal mid-line somewhat obliquely, and thus acquire a slightly boomerang outline when viewed from behind.

Cranial Characters.—Five skulls have been available for examination (South Austr. Mus., Reg. Nos. M1760, M1761, M1762, M2120, M2121), and of these the first four form a fairly uniform series as to relative dimensions and general outline, although two only (M1762 and M2121) are adult in the sense that the permanent premolar has erupted.

In the high facial index, the wide unconstricted interorbital region, the relatively complete palate and the extremely small size of the second and third incisors, the main cranial characters enumerated for this species by Oldfield Thomas (1) are very evident. The latter author, however, states that the nasal bones "are short, broad, and enormously expanded behind." In all four of the skulls enumerated above the whole of the muzzle region, and with it the nasals, is very long, and although the posterior expansion is considerable in all, it cannot be described as enormous in any one of them. In the two slightly immature skulls the expansion may be said to be marked as compared with other large wallabies, but it falls considerably short of the condition figured by Thomas, and in the two adults is scarcely greater than frequently occurs in *M. ruficollis*. With regard to the length of the nasals, it is apparent from the measurements given by Thomas that the term "short" can hardly apply. The mean value of the ratio of the length of the nasals to the basal length of the skull in the two examples measured by him is 2·00, which is less than the value of the same ratio in *M. irma* and *M. agilis* (2·02 and 2·15, respectively), both of which are said to have long nasals. In the

two adult skulls in the South Australian Museum the ratio has fallen to 1·98, which indicates in *M. greyi* a relative length of the nasals greater than that of any other species of the subgenus.

It is very noticeable in all five skulls that the teeth are in excellent condition; not only is there an almost complete freedom from the usual incrustation of the molars, but all the teeth, both cheek teeth and incisors, show very little signs of wear. In most of the species of all three groups of *Macropus* the wear on the incisors is so considerable that, by the time the last molar is in place, the enamel of the first incisor has been reduced to two-thirds, or even one-half, of its original area. In the two adult skulls at hand, however, although the fourth molar has been in use for some time the size and shape of the first incisors show no modification from that of the same teeth in the three immature skulls. In all, the enamel surface of the tooth extends to the alveolar margin without disclosing any sign of the dentine root. This long duration of the incisors is no doubt correlated with the marked preference of the Toolach for a grazing, rather than a browsing, habit.

In connection with the teeth it may also be noted that in one skull (M2121) the appearance of the permanent premolar has been delayed to such an extent that it has been preceded in the jaw by the fourth molar. Using the British Museum Catalogue nomenclature, it may be said that in the right upper jaw of this skull, P^3 and MP^4 coexist with M^4, while P^4 is still beneath the bone. This extraordinary condition is of rare occurrence in *Macropus*, and the only other example of it which I have observed was presented by a skull of *M. irma*.

From a consideration of the general characters of the skull and its dentition Thomas (1) has advanced the view that *M. greyi* is in reality "a comparatively recently enlarged member of the group of small wallabies," and there is some support for his contention in certain of its habits. This is particularly true of its semi-gregariousness and localised, discontinuous distribution throughout its range, which are both strongly reminiscent of the mode of occurrence of the small wallabies.

Within the limits of the subgenus *Wallabia* its relationships are undoubtedly closest to *M. irma*, as pointed out by both Gould and Waterhouse. In the skull this is evinced by the diminutiveness of the second and third incisors, but the retention of a broad unconstricted interorbital region throughout life, and by the relatively complete palate. Externally it is shown in the great reduction in the size of the fore limb and manus, by several peculiarities in the structure of the pes, by the presence of a caudal crest, and by a general correspondence in the details of their ornamentation, this last being especially marked in the common possession of a system of loin bands absent in all other species of the genus *Macropus*, and paralleled by only one other species in the entire family Macropodidae.

M. irma is a western species which to-day is isolated from *M. greyi* by an immense tract of country totally unfitted as a habitat for either, and it is of considerable interest, therefore, that the affinities of the latter should be with the isolated *M. irma* rather than with the five other species, whose several habitats in Eastern Australia are practically continuous with one another, and linked also with its own.

According to the views of Bensley (13) the mutual relationships of the two species are not derivative, but are to be attributed rather to the parallel and quite independent evolution of two Large Wallabies from a common ancestral Small Wallaby, probably *Thylogale eugenii*. The explanation is an attractive one, but its unreserved acceptance is not without difficulties, and further enquiry is hampered by the fact that the Thylogale of the South Australian mainland has been exterminated before its identity was properly established.

Skull Measurements of Macropus greyi, in S.A. Museum.

(In millimetres.)

	M1760. Imm. (no sex)	M1761. Imm. (no sex)	M1762. Male. Adult.	M2121. Female. Adult.	M2120. Male. Imm.
Greatest length	120	119	124	124	98 (ca)
Basal length*	101	101.5	109.5	110	82 (ca)
Zygomatic breadth	60	58	59	58	58
Nasals, length	51	53	57.5	56	42
Nasals, greatest breadth	20.5	24	22	21	18
Nasals, overhang	9	10	9	9	—
Depth of muzzle†	22	23	27.5	24.5	20
Constriction	20.5 (inter-orbital)	21.5 (inter-orbital)	18 (inter-temporal)	21.5 (inter-temporal)	—
Palate, length	66	68.5	73.5	73	52
Palate, breadth inside M^2	21	21.5	23	22	17
Palatal foramina	7	7	6.5	8	—
Diastema	30	31	33	34	—
Basi-cranial axis	29	28	31	31	25
Basi-facial axis	76	77.5	82.5	83	60
Facial index	262	277	266	267	240
Molars 1-3	20	20	19.5	19.5	—
P^4	—	—	6	—	—
I^1 Antero-posterior length x vertical height (of enamel)	11 x 4.5	12 x 4.5	10.5 x 5	11.5 x 4.5	—
I^2	5 x 3.5	4.5 x 3	4.5 x 3	5 x 3	—
I^3	5.5 x 4	4.5 x 3.5	4.5 x 4	4 x 4.5	—

*From the anterior margin of the *foramen magnum* to the most anterior point on the *premaxillae*.

†Measured by a perpendicular through the mid-point of the diastema.

List of References.

1. O. Thomas, "Catalogue of Marsupialia and Monotremata in the British Museum." 1888.
2. Angel Cabrera, "Genera Mammalium: Monotremata and Marsupialia." Madrid, 1919.
3. H. Longman, "Memoirs of the Queensland Museum," vii., 1922, p. 298.
4. F. Wood Jones, "Mammals of South Australia, 1923-1925." Adelaide.
5. John Gould, "Mammals of Australia," ii., 1863. London.
6. A. Zietz, "List of South Australian Kangaroos and Wallabies," Trans. Roy. Soc. S. Austr., xv., 1892, p. 18.
7. J. E. Gray, "List of Mammals in the British Museum." 1843.
8. G. R. Waterhouse, "A Natural History of the Mammalia," i. 1846.
9. F. Wood Jones, "The Hair Pattern of a Kangaroo: a Study of Cause and Effect," Journ. of Mammalogy, vi., No. 1, 1925, p. 13.
10. Baldwin Spencer, "Report on the Work of the Horn Scientific Expedition to Central Australia, 1896," pt. 1, Mammalia, p. 41.
11. J. Gilbert, Proceedings of the Zoological Society, London, xii., 1844, p. 33.
12. Gerard Krefft, "The Mammals of Australia," 1871. Sydney.

Fig. 1.
Typical "Toolach country," County of Grey, South Australia.

Fig. 2.
M. greyi (adult female), showing characters of head and usual position of hands.

Photo by H. H. Finlayson.

Gillingham & Co. Limited, Printers, Adelaide.

Fig. 1.
M. greyi (adult female), showing general bearing and carriage of tail when moving at speed.

Fig. 2.
M. greyi (adult female), showing dorsal banding and caudal crest.

Photo by H. H. Finlayson.

Gillingham & Co. Limited, Printers, Adelaide.

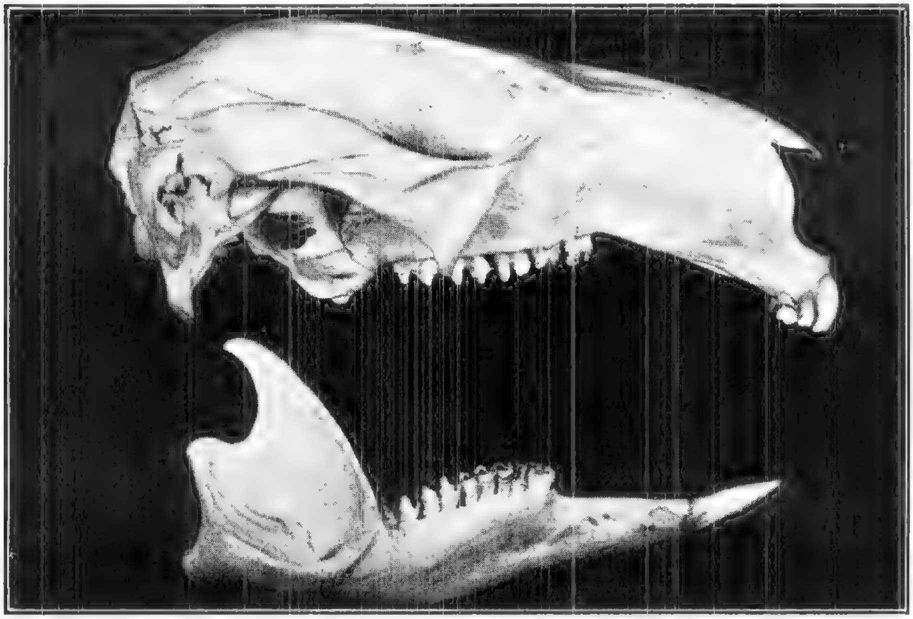


Fig. 1.

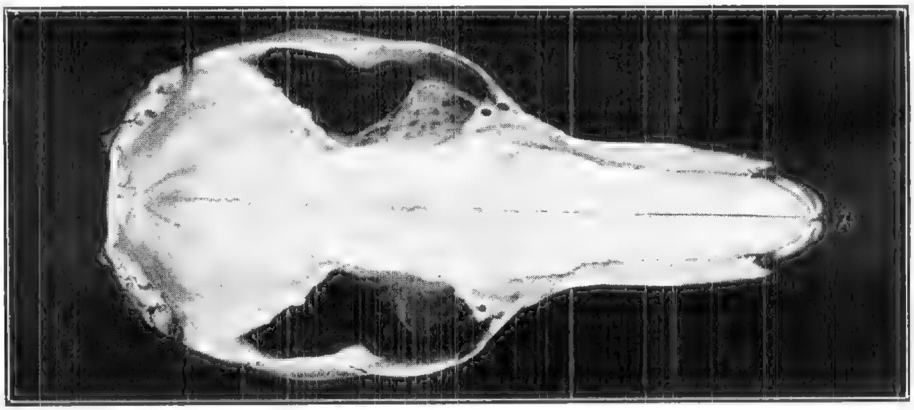


Fig. 2.

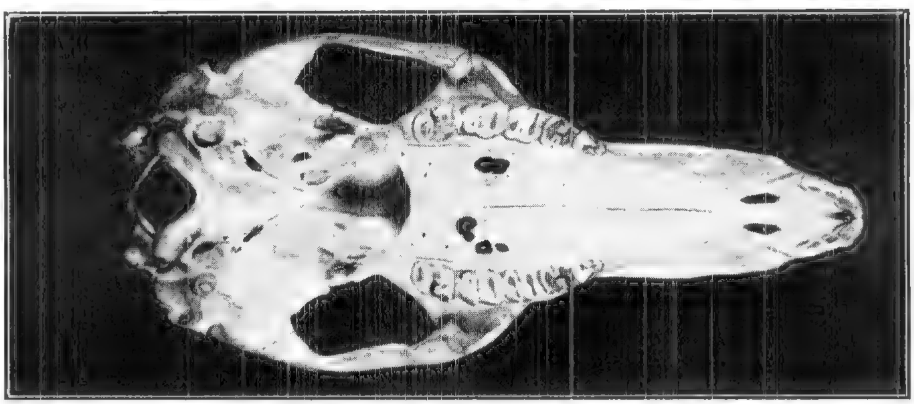


Fig. 3.

Lateral, superior and palatal views of skull of *M. greyi* (adult male, South Australian Museum. M1762).

Photo by T. M. A. Boys.

Gillingham & Co. Limited, Printers, Adelaide.

13. B. Arthur Bensley, "On the Evolution of the Australian Marsupialia, with remarks on the Relationships of the Marsupials in general." Transactions of the Linnean Society (London), (2), ix., pp. 83-217 (1903).

DESCRIPTION OF PLATES XVI. to XVIII.

Plate XVI.

Fig. 1. Typical "Toolach country," County of Grey, South Australia.

Fig. 2. *M. greyi* (adult female), showing characters of head and usual position of hands.

Plate XVII.

Fig. 1. *M. greyi* (adult female), showing general bearing and carriage of the tail when moving at speed.

Fig. 2. *M. greyi* (adult female), showing dorsal banding and caudal crest.

Plate XVIII.

Figs. 1, 2, and 3. Lateral, superior and palatal views of skull of *M. greyi* (adult male, South Australian Museum, M1762).

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA.

No. 25.

By J. M. Black.

[Read October 13, 1927.]

Cyperaceae.

Heleocharis halmaturina, n. sp. Planta parva glabra gracilis perennis, caulibus tenuibus sed rigidiusculis 4-8 cm. longis subcompressis ½ mm. latis secus unum latus sulcatis arcuatis vel subflexuosis, foliis fere ad vaginas brunneas basilares reductis, vaginis supremis in acumen subulatum 2-5 mm. longum desinentibus, spiculis solitariis terminalibus linearibus acutis 6-7 mm. longis vix 1 mm. latis, glumis circ. 6, infimâ subulatâ ad basin duabus auriculis membranaceis instructâ erectâ bracteiformi reliquum spiculae subaequante, secundâ breviusculâ obtusâ mucronatâ, ceteris glumis lineari-oblongis acutis subaequalibus rubellis dorso uninervibus, glumâ terminali florem solitarium bisexualem cum glumâ minutâ includente, staminibus 3, styli ramis 3 elongatis ejusque basi conicâ persistente puberulâ 3 mm. longa, setis hypogynis 6 superne barbellatis, nuce maturâ non visa.

Rocky River, Kangaroo Island, coll. J. B. Cleland. The solitary terminal flower is peculiar, but in other respects this little plant agrees with *Heleocharis*. The spikelet closely resembles that of *Cladium capillaceum* but is always terminal and solitary and is also distinguished by the presence of hypogynous bristles.

Gahnia hystrix, n. sp. Plantula perennis hystriciformis 4-15 cm. alta, caulibus confertis erectis ramosis basin versus vaginis fuscis veterum foliorum obtectis, foliorum laminis teretibus rigidis pungentibus erectis 2-5 cm. longis circ. ½ mm. latis confertis paniculam parvam spiciformem terminalem superantibus et fere celantibus, spiculis subsessilibus circ. 4, supremis geminis, ceteris solitariis, omnibus primo albidis angulatisque denique brunneis et ovoideo-acutis 6-7 mm. longis in vaginis bractearum foliosarum plus minusve inclusis, glumis 5, 4 inferioribus latis subaequalibus breviter aristatis, quartá florem solitarium bisexualem glumamque quintam minimam includente, staminibus 6, stylo brevi tereti caduco breviter trifido, setis hypogynis nullis, nuce obovoideâ albo nitente inferne trigono cum punctillo apicali nigro disjunctionem styli notante.

Cape du Couëdic, Kangaroo Island, coll. J. B. Cleland; Cape Borda, coll. J. G. O. Tepper. The flowering glume is as large as the others, but the 6 stamens and the absence of any swelling towards the base of the style indicate *Gahnia* rather than *Cladium*.

Portulacaceae.

Calandrinia sphaerophylla, J. M. Black. Herbula annua 1-2 cm. alta, caulibus adscendentibus, foliis carnosis 3-5 mm. longis obovoideis vel subsphaericis basin versus parum attenuatis, racemis paucifloris, bracteis parvis acutis, pedicellis 3-5 mm. longis fructiferis reflexis vel patentibus, sepalis roseis orbicularibus fere 2 mm. longis, petalis 5 albidis ovatis sepala aequantibus, staminibus 6 vel interdum paucioribus inferne in annulum coalitis, antheris globosis, stylis 3 brevibus latis, capsulâ roseâ ovoideâ calyci subaequilongâ 3-valvi, seminibus ca. 15 nitentibus sed minute granulatis vix ½ mm. diam.

Near Port Lincoln. Resembles *C. pygmaea* in size, but differs in the reflexed pedicels, thinner not deciduous sepals, obtuse petals, filaments united about the middle, broad not slender styles and pale capsule splitting almost to base. Collected in 1925 without indication of exact locality.

Calandrinia dipetala, n. sp. Herbula annua, caule singulari erecto 5-10 mm. alto racemum terminalem saepius 3-florum ferente, foliis paucis carnulentis obovoideis 2-3 mm. longis, pedicellis 2-4 mm. longis ad basin minute bracteatis fructiferis patentibus vel reflexis, sepalis suborbicularibus rubellis apiculatis circa 2 mm. longis, petalis 2 obovatis purpurascentibus cum sepalis alternantibus et eis denique fere duplo longioribus, staminibus 3 liberis, antheris globosis albis, stylis 3 brevibus, capsulâ membranaceâ calycem paulo superante, ovulis circa 10 sed tantum 2 ampliatis et maturescentibus, seminibus maturis non visis.

Myponga; coll. J. B. Cleland. This is probably the smallest of all *Calandrinias*, and as it grows among moss is liable to be overlooked. The leaves are much like those of *C. sphaerophylla*, but rather smaller. The single weak stem, the 2 petals, alternate with the sepals, the 3 free stamens and the longer capsule distinguishes it from that species.

Calandrinia stagnensis, n. sp. Herbula annua, caulibus adscendentibus 7-10 cm. longis, foliis tereti-clavatis superne ca. 2 mm. crassis, radicalibus 1-3 cm. longis, caulinis 5-15 mm. longis, floribus 3-5 in racemos terminales foliosos vel paniculas breves cymosas dispositis, pedicellis 4-8 mm. longis fructiferis erectis folio aequilongo et bracteâ parvâ scariosâ suffultis, sepalis latis apiculatis florentibus 2½ mm. longis fructiferis 4 mm. longis, staminibus 8-9, filamentis base valde dilatatis, styli ramis 4 latis plumosis, capsulâ conicâ obtusâ quam calyx sublongiore 4-valvi, ovulis numerosis, seminibus rubellis laevibus nitentibus ca. ⅓ mm. diam.

Ross's waterhole, Macumba River, coll. J. B. Cleland. Differs from *C. ptychosperma* in the narrower leaves, leafy racemes and smooth seeds, which closely resemble those of *C. pumila*.

CHENOPODIACEAE.

Kochia enchylaenoides, n. sp. Suffrutex, caule cum ramis et foliis tomento lanoso albo obtectis, foliis linearibus obtusis crassiusculis patentibus 5-10 mm. longis 1 mm. latis, floribus solitariis in omnibus axillis ramorum brevium patentium, perianthio fructifero depresso-globoso in sicco nigrescente 4-5 mm. lato cum alâ angustâ horizontali ca. 1 mm. latâ apicem tubi hemisphaerici laevis cingente, toto perianthio glaberrimo praeter lobos minimos ciliatos, radiculâ parvam gibbam lateralem formante ut in fructu *Enchylaenae tomentosae*.—*K. tomentosa* (Moq.) F. v. M. var. *enchylaenoides*, J. M. Black in Trans. Roy. Soc. S.A. 47: 368 (1923).

Yellow Cliff, near Charlotte Waters. Coll. S. A. White. None of the fruits are quite ripe, so that the wing may possibly become somewhat broader. Differs from *K. tomentosa* in the whiter more woolly tomentum and the thicker very narrow wing or border surrounding the summit of the perianth-tube. The fruiting perianth resembles that of *Enchylaena tomentosa* in its depressed shape and also in the small protuberance on one side to accommodate the tip of the radicle; probably when ripe and fresh it is somewhat succulent. The chief difference is that *E. tomentosa* has no wing, and *K. enchylaenoides* may perhaps be regarded as a transition form connecting the 2 genera.

LEGUMINOSAE.

Swainsona Behriana (F. v. M. Herb.), n. sp. Herba perennis gracilis 10-20 cm. alta pilis brevibus basifixis pubescens, caulibus adscendentibus, foliolis 5-13 obtusis emarginatis vel acutis lineari-lanceolatis usque ad oblongo-cuneata plus minusve pubescentibus interdum supra subglabris et margine subincurvis 4-20 mm. longis 1-4 mm. latis, foliolis foliorum inferiorum saepius quam ea superiorum latioribus, stipulis late lanceolatis ca. 3 mm. longis, pedunculis gracilibus 4-10 cm. longis folia multo superantibus

umbellam terminalem 3-8-floram vel raro racemum brevissimum ferentibus, floribus purpureis, pedicellis 2-5 mm. longis, bracteis parvis, bracteolis minutis, calyce 4-5 mm. longo pilis nigris pubescente, dentibus lanceolatis tubo fere aequilongis, vexillo ca. 8 mm. longo 10 mm. lato haud vel paene emarginato omnino vel fere ecalloso, carinâ obtusâ non sacculatâ alas vix superante vexillum fere aequante, stylo totâ longitudine breviter barbato ad apicem abrupte inflexo, legumine oblongo obtuso pubescente 12-15 mm. longo 5-6 mm. lato.—*S. lessertiifolia*, DC. var. *tephrotricha*, Benth. Fl. Aust. 2:222 (1864) in parte; *S. oroboides*, F. v. M. var. *hirsuta*, J. M. Black, Fl. S. Aust. 320 (1924).

Southern districts to southern part of Flinders Range; Murray lands.—Victoria; New South Wales.

Belongs to section *Basitrichae*. Differs from *S. oroboides* in more numerous, shorter, often obtuse or notched leaflets, broader stipules and usually smaller calyx with black hairs and broader teeth rather shorter than the tube, whereas in *S. oroboides* the hairs of the calyx are white and the teeth slender and distinctly longer than the tube; from *S. lessertiifolia* by the fewer, smaller, more hairy leaflets, the much fewer and umbellate flowers and the style abruptly inflexed at summit; from *S. tephrotricha* it is widely removed by the basal attachment of the hairs, the usually thinner pubescence, the fewer mostly umbellate flowers, the shape of the style, the keel without pouches, &c. The name *S. Behriana* was published by Mueller without description in a letter to the *South Australian Register* printed 19th Feb. 1850, and is attached to the type specimen preserved in the Kew Herbarium and kindly lent to me. The label reads:—"*Swainsona Behriana*, F. Müller. In planitie graminosa ad Adelaide. Dr. F. Müller.—Herbar. W. Sonder." The specimen, of which co-types can still be found on the Adelaide plains, was evidently sent by Mueller to Dr. Sonder, of Hamburg, and was doubtless named after Dr. Behr, a physician and botanist then practising at Gawler. In the Kew Herbarium it is placed under *S. lessertiifolia*, DC. var. *tephrotricha* (F. v. M.) Benth. (=*S. tephrotricha*, F. v. M.), an error which doubtless goes back to Bentham's time and has been the source of much confusion in the naming of Australian specimens. It stands nearest to *S. reticulata*, having the same comparatively short calyx-teeth, but the hairs are mostly black, giving the calyx a darker appearance; and the flowers are umbellate rather than racemose. In the typical form, which extends from Encounter Bay to Jamestown, and is found in several parts of Victoria, the flowers are a deep purple, fading into blue, the standard without any calli and with 2 greenish spots near the base of the lamina, but in some specimens from the northern areas and the Murray lands the flowers are not so strictly umbellate, the standard has 2 small calli and there is a tendency to pass over into *S. reticulata*. *S. tenuis*, E. Pritzel in Engl. Bot. Jahrb. 35; 270 (1904), a West Australian species of which I have not seen a specimen, appears to be nearer to *S. oroboides* than *S. Behriana*. Judging by the strong resemblance of the drawing, *S. tephrotricha*, Maiden, Ill. N.S.W. Pl. 77, plate 28 (1911), non F. v. M., figured from Victorian specimens, is *S. Behriana*.

Swainsona rigida (Benth.) n. sp. Herba perennis erecta 60 cm. usque ad 1 m. alta vel ultra, caulibus rigidis glabris, foliis distantibus inconspicuisque, foliolis ca. 15 subsessilibus obovato-cuneatis emarginatis caducis 2-5 mm. longis pilis basifixis adpresso-pubescentibus, stipulis parvis ovatis pubescentibus, pedunculis usque ad 25 cm. longis superne racemum laxum sub-20-florum ferentibus, floribus flavis, bracteis et bracteolis minutis, calyce 5 mm. longo sparse pubescente minute dentato, vexillo ovato ecalloso ca. 15 mm. longo 10 mm. lato, stylo ut in *S. laxâ*, legumine planiusculo oblique ovato ca. 12 mm.

longo 7-8 mm. lato reticulato glabro saepius tantum unum alterumve semen maturante, stipite calycem subaequante.—*S. laxa,* R. Br. var. (?) *rigida,* Benth.

Minnie Downs, near Diamantina (Warburton) River, coll. L. Reece; near Lake Callabonna, coll. J. B. Cleland. Differs from *S. laxa* in much smaller hairy leaflets, longer peduncles, larger and pubescent calyx with teeth only ¼ the length of the tube, while *S. laxa* has teeth nearly as long as the tube. Belongs to the section *Basitrichae.*

Swainsona fissimontana, n. sp. Herba perennis 20-30 cm. alta, caulibus erectis vel adscendentibus pilis centrifixis adpresso-pubescentibus, foliolis 7-11 similiter pubescentibus 8-15 mm. longis, iis foliorum inferiorum oblongis foliorum superiorum lineari-lanceolatis, stipulis lineari-lanceolatis 5-8 mm. longis, pedunculis rigidiusculis glabrescentibus 12-20 cm. longis prope apicem racemum laxum 5-9-florum ferentibus; calyce 5-6 mm. longo pilis nigris pubescente, dentibus lanceolatis tubo fere aequilongis, vexillo rubello ecalloso ca. 12 mm. longo 15 mm. lato, carinâ saturate rubrâ incurvâ ad unum latus tortâ bisacculatâ, alis quam carina brevioribus, stylo prope basin torto fere totâ longitudine barbato a basi incurvo sed apice haud abrupte inflexo, legumine oblongo 25-30 cm. longo adpresso-pubescente secus suturam impresso.

Boolcoomatta and Koonamore Stations (north of the Broken Hill Railway in South Australia;) coll. A. Morris.—Broken Hill district, N.S. Wales. Section *Mesotrichae.* Differs from *S. stipularis* in the stouter rigid almost glabrous peduncles, narrower stipules, usually narrower leaflets and longer pods; from *S. Morrisiana* in the broader shorter leaflets, larger flowers, standard darker and not streaked, the keel pouched and the style not so much twisted nor with an almost terminal ring of hairs; from *S. phacoides* in the thinner coating so that the leaflets appear greener, smaller flowers, absence of calli on the standard and pod not cylindrical but broader and dilated about the middle; from *S. tephrotricha* by a greener appearance, usually fewer flowers in the raceme and the twisted keel and style; from all these other species of the section *Mesotrichae* it differs in the glabrous or almost glabrous peduncles. The type-specimens are Mr. Morris's numbers 26, 1346, 1449, 1450, from Koonamore, S.A. and Thompson's Siding, near Broken Hill. The species is the most common *Swainsona* near that town and has been named after it. Color of flowers "magenta," according to the collector.

S. tephrotricha, F. v. M. The type of this species is in the Kew Herbarium and agrees in all respects with specimens collected east of the Flinders Range towards the country lying between Lake Frome and the Burra. The label of the type-specimen is inscribed:—"*Sw. tephrotricha,* F. Müll. Nov. Holl. austr. inter. Dr. F. Müller. Herbar. W. Sonder." The species has not so far been found in any of the other States. The only genuine localities quoted by Bentham, Fl. Aust. 2:222 (1864) are "Broughton, Hutt and Hill Rivers" (erroneously placed in Victoria instead of South Australia) and "Burra-Burra." The specimens quoted as from other localities are referable to *S. Behriana* or some other species .

I have examined, by the courtesy of Mr. J. W. Audas, Curator of the Victorian National Herbarium, 4 specimens included under the name of *Swainsona stipularis* in Baron v. Mueller's time. The first has the following label:—"*Swainsona stipularis (S. phacifolia).* Akaba, Nov. Holl. aust. interior, Oct. 1850 v. 1851, coll. F. Mueller." ("Akaba" is a clerical error for "Arkaba," an error repeated in the Flora Australiensis. "Akaba" is preceded by the name "Cudnaka," which has been struck through by the pen, Mueller being apparently in doubt as to the exact locality. "Cudnaka," which occurs on the labels of several specimens collected by Mueller on his journey to the neighbourhood of Lake Torrens, is not known in the South Australian Land Office, but is probably the same as Kanyaka, which lies on the direct route from Melrose to Arkaba. In the year 1851 Melrose was the most northerly town in South Australia). The leaflets are 7-13 in number,

oblong-cuneate, 10-15 mm. long, 2-3 mm. broad and bluntly notched at summit, like those of *S. adenophylla*, but without the gland; the stipules are broadly ovate, acute, 6-12 mm. long, 6-8 mm. broad near the base, with a few coarse teeth on the margin. The whole plant is hoary with appressed basifixed hairs; racemes 8-9-flowered. The name *S. phacifolia* was published (as *S. phacaefolia)* in the *South Australian Register* of 19th Feb., 1850, without any description and has since then remained a *nomen nudum*, because Mueller renamed and described it in Linnaea 25:393 (1852) as *S. stipularis*. The description and the locality given in Linnaea leave no doubt as to the identity of the plant:—"Pilis appressis canescens, foliolis 5-6-jugis lineari-cuneatis emarginatis, racemis brevibus longe pedunculatis 6-9-floris, stipulis magnis triangularibus acutis grosse paucidentatis, stylo postice apicem versus barbato. Prope Arkaba." *S. phacifolia* is therefore merely a synonym of *S. stipularis*. Specimens similar to the Arkaba type can be gathered to-day at Quorn, Hawker, Arkaba, Leigh's Creek, Nilpena and other places in the Flinders Range as far north as Lake Eyre, eastward thereof at Carrieton, Orroroo and Boolcoomatta, and over the New South Wales border into the Broken Hill country. The leaflets vary much in size; they are often merely obtuse, not notched, and those of the upper leaves may be lanceolate and acute. The stipules, although always broad at base, are sometimes entire. The discrepancy between the date of publishing the name of *S. phacifolia* (Feb. 1850) and the date of collection in Oct. 1850 or 1851 (in Fragm. 9:154 Mueller defines it, under the name *S. phacifolia*, as 1851), is puzzling. It is possible that Mueller at first intended giving it to some other South Australian plant, then affixed it to his Arkaba specimen and finally decided to replace it by what he considered the more appropriate one of *S. stipularis*. It is under the latter name that the species appeared in his Census and in his Key to the System of Victorian Plants; in the Key *S. phacifolia* is quoted as a synonym.

The second specimen received from the Melbourne Herbarium is labelled "*S. phacifolia*. Towards Spencer's Gulf; coll. Warburton." It is the one alluded to by Mueller in Fragm. 9:154 (1875) and agrees entirely with the type of *S. stipularis*.

The third specimen is labelled "*S. phacifolia*. Between the Wimmera and Richardson Rivers; coll. H. Curdie." This is *S. Morrisiana*.

The fourth specimen is labelled "*S. phacifolia*. Mount Kingston; coll. J. M. Stuart." Mount Kingston is situated west of Lake Eyre, about 12 miles from Algebuckina station on the Oodnadatta railway. This is a small plant, hoary with appressed centrifixed hairs, 5-7 rather long linear leaflets, linear-lanceolate stipules, small flowers and the style abruptly inflexed at summit, as in *S. oroboides* and *S. Behriana*. It is not *S. stipularis* and is probably an undescribed species. It appears to be the only specimen of the kind which has been collected.

S. adenophylla, described in these Transactions 50:284 (1926), is near *S. stipularis*, but appears to be constantly distinguished by the gland in the sinus of the obtusely notched leaflets, the smaller bright purple flowers and the slender style shortly bearded all the way, instead of a broader rigid style with a long beard only towards the summit.

Sterculiaceae.

Hermannia Gilesii, F. v. M. Fragm. 9:42 (1875). This genus and species must be added to the flora of South Australia, because investigation has shown that *Corchorus longipes*, Tate *(Hymenocapsa longipes* (Tate) J. M. Black) does not belong to the family *Tiliaceae*, but is really the same as *Hermannia Gilesii* and must therefore be placed in the section *Hermannieae* of *Sterculiaceae*. This result is due to the careful observations of Mr. M. Burret, of the Berlin Botanical Garden and Museum (Beiträge zur Kenntnis der Tiliaceen in Notizbl. des Bot. Gart. u. Mus. Berlin-Dahlem, 9:1173 (1927). The only 2 known specimens are

the typical one, collected by Giles near Charlotte Waters (National Herbarium of Victoria), and the one in the Tate Herbarium collected near Farina, in the Flinders Range. They differ somewhat as regards the shape and size of the leaf, but not in a specific degree, as far as one can judge from the somewhat scanty material. If it should ever be considered necessary to separate them specifically, the new name would be *H. longipes* (Tate) Burret, l.c. Mr. Burret, however, agrees with me that we have not at present any evidence to justify the creation of a new species. Mr. J. W. Audas, Curator of the Victorian Herbarium, informs me that *H. Gilesii* was recorded as collected by J. D. Batt near Eucla in 1889, but unfortunately the specimen is not in the Herbarium.

Violaceae.

Hymenanthera angustifolia, R. Br. was found in the gorge of the Onkaparinga in 1882. Since then—a period of 45 years—it has not been recorded, until in September of this year it was discovered by Professor J. B. Cleland on Mount Remarkable and by myself close to the Torrens Valley Road.

Bignoniaceae.

Tecoma doratoxylon, n. sp. Frutex glaber 3-5 m. altus, ramis strictis non volubilibus, foliolis 5-11, anguste lanceolatis 2-5 cm. longis 3-8 mm. latis integris, rhachi canaliculatâ, floribus paniculas terminales foliosas formantibus, calyce campanulato 4-5 mm. longo obtuse breviterque 5-lobato, corollâ infundibuliformi circiter 25 mm. longo albido, tubo glabro rubello-striato quater longiore quam limbus intus et extus puberulus, capsulâ longâ valvis cymbiformibus dehiscente; seminibus planis late alatis.—*T. australis*, Benth. non R. Br.

Alberga River westward to Musgrave Range. Also in Central Australia. Known to bushmen as "Spearwood Bush." The long straight stems are used by the natives for making spears. Nearest to *T. Oxleyi*, A. Cunn., which has twining stems and branches and smaller and narrower leaflets.

Goodeniaceae.

Goodenia unilobata, n. sp. Herba, caule gracili tereti ad apicem crispulo-incano ceterum glabro (parte inferiore ignotâ), foliis caulinis pedunculos subtendentibus subglabris oblongis obtusis tenuibus 2-3 cm. longis 4-5 mm. latis integris vel margine denticulatis et basi in lobum oblongum patentem unilateralem 3-12 mm. longum productis, petiolo tantum 2 mm. longo, pedunculis solitariis 1-floris folio brevioribus prope medium duabus bracteolis angusto-linearibus instructis, sepalis linearibus acutis 6-7 mm. longis quam receptaculum obconicum primo incanum longiore, corollâ flavâ 20-25 mm. longâ extus sparsim pubescente intus glabrâ, 2 lobis superioribus auriculatis et impariter alatis, stylo 7-8 mm. longo fere glabro, indusio subglabro ad apicem brevissime ciliato, dissepimento ovarium longitudine fere aequante, ovulis circ. 18 biserialibus, capsulâ non visâ.

Only known by a fragmentary specimen in the Tate Herbarium labelled "Ooldea," without collector's name. The peduncles bibracteolate about the middle bring this species near to the *geniculata* group, but the leaves—of which only the upper ones are known—are peculiar, terminating, as most of them do, in a large basal unilateral lobe, which resembles a prolongation of the leaf downwards.

Goodenia subintegra, F. v. M. in Vict. Nat. 5:13 (1888). Herba perennis, caulibus erectis vel adscendentibus 5-30 cm. longis sparse adpresso-pubescentibus, foliis plus minusve adpresso-pubescentibus, radicalibus cum petiolo 3-10 cm. longis 4-18 mm. latis, junioribus caducis late lanceolatis vel

obovatis saepe obtusis integris vel paucidentatis interdum lyratis vel grosse crenatis, serioribus latiuscule lanceolatis acutis saepius integris, foliis caulinis 1-3 petiolatis lanceolatis vel lineari-lanceolatis, pedunculis 2-7 cm. longis pubescentibus axillaribus 1-floris ebracteolatis quam folia floralia angusta saepius multo longioribus interdum ad apicem caulium fasciculatis, sepalis lanceolatis 4-5 mm. longis pubescentibus, corollâ flavâ 15-25 mm. longâ extus argenteo-pubescente, lobis 2 inferioribus auriculatis, stylo 3-6 mm. longo glaberrimo vel interdum intus prope apicem barbato, indusii dorso glabro, antheris apiculatis, capsulâ obovoideâ subcompressâ basin versus saepius angustatâ 7-10 mm. longâ, dissepimento trientem usque ad fere dimidium capsulae aequante, seminibus brunneis planis ovatis punctulatis 5-7 mm. longis alâ albâ 1-2 mm. latâ adnumeratâ.—*G. glauca*, F. v. M. var. *sericea*, Benth. (1869).

Murray lands to Flinders Range and Far North.—Western Victoria and New South Wales; Central Australia.

G. subintegra was very imperfectly described by Mueller in the Victorian Naturalist as a distinct species or a variety of *G. glauca*, and his statement that Bentham had already treated it as a variety of that species shows that Mueller considered it equivalent to var. *sericea*. The comparison with other species and the localities quoted by Mueller go to prove the same thing. As a varietal name *sericea* has a priority of nearly 20 years, but when that variety is raised to specific rank (as I think it should be) Mueller's specific name takes precedence in accordance with art. 49 of the international rules.

G. subintegra differs from *G. glauca* in the appressed clothing, which is sometimes silky, the style glabrous or almost so, the indusium glabrous on back, the capsule larger and obovoid instead of globular, the seeds much larger and more broadly winged. It is to the observations of Mr. A. Morris, who cultivated this species in his garden at Broken Hill, that we owe accurate knowledge about the broad early lobate caducous leaves, which differ so much from the later lanceolate leaves that early and late plants could easily be taken for distinct species or at least varieties.

Goodenia lunata, n. sp. Herba perennis, caulibus erectis vel adscendentibus 6-20 cm. longis basi lanatis, foliis subrigidis adpresse incano-pubescentibus, radicalibus oblongo-lanceolatis acutis 4-7 cm. longis in petiolo longiusculo angustatis, exterioribus saepe integris, plerisque in lobos lanceolatos acutos patentes 8-20 mm. longos pinnatifidis, lobo terminali lateralibus longiore, foliis caulinis nullis vel tantum uno lanceolato integro, foliis floralibus angustis quam pedunculi erecti pubescentes 1-flori axillares vel fasciculato-terminales ebracteolati vix brevioribus, sepalis 3-4 mm. longis, corollâ flavâ circ. 15 mm. longâ extus et intra tubum pubescente, lobis omnibus late alatis 2 superioribus auriculatis, stylo glabro brevi, indusii dorso glabro ejusque apice brevissime sparsimque ciliato, capsulâ ovoideâ 7-10 mm. longâ, dissepimento minimo lunato quadrantem capsulae vix aequante, seminibus suborbicularibus brunneis cum alâ latâ circ. 5 mm. permetientibus.

Cordillo Downs and Macumba River, coll. J. B. Cleland; Alberga River, H. W. Andrew. Differs from *G. subintegra*, F. v. M. in the more rigid leaves with longer lobes, the inconspicuous ciliation of the indusium and the minute dissepiment.

Goodenia argentea, n. sp. Herba debilis adpresse denseque argenteo-pubescens, caulibus tenuibus erectis vel adscendentibus 10-20 cm. longis, foliis radicalibus lineari- vel oblongo-lanceolatis basin versus angustatis cum petiolo longo 3-12 cm. longis, 2-7 mm. latis integris vel 2-4 lobis dentibusve linearibus 4-20 mm. longis marginatis, foliis caulinis 1-2 angusto-linearibus, foliis floralibus angustissimis pedunculos filiformes axillares 1-floros ebracteolatos 2-6 cm.

longos subaequantibus, sepalis circ. 3 mm. longis, corollâ albâ (vel dilute flavâ?) 14-16 mm. longâ extus et intra tubum pubescente, lobis omnibus late rotundato-alatis duobus superioribus auriculatis, antheris apiculatis, stylo 3 mm. longo glabro, indusii dorso et apice fere glabris, dissepimento medium ovarii attingente marginibus piloso, ovulis circ. 12 alatis, fructu non viso.

Strangways Springs (west of Lake Eyre) coll. W. L. Cleland; Yadlakina Soakage (east of Lake Torrens). Differs from *G. subintegra*, F. v. M. in the very slender weak stems, narrower flaccid leaves and the cilia of the indusium almost obsolete.

G. heteromera F. v. M. n. var. *deminuta*. Forma pumila basi lanata, foliis radicalibus cum petiolo 5-15 mm. longis, pedunculis filiformibus sub flore valde lanatis modo omnibus radicalibus 15-20 mm. longis modo in caulem brevem insertis, indusii dorso glabro.

Near the Wilson River, south-western Queensland and not far from our border, coll. W. D. K. MacGillivray.

Goodenia anfracta, n. sp. Herba perennis humilis glabra absque axillis lanulatis, caulibus procumbentibus anfractis tenuibus sed rigidis circ. 10 cm. longis, foliis radicalibus omnino vel fere integris lanceolatis vel obovato-cuneatis cum petiolo brevi 15-20 mm. longis, foliis caulinis linearibus crassiusculis distantibus ramos pedunculosque subtendentibus basin versus paulo angustatis 20-25 mm. longis circ. 1 mm. latis saepe falcatis, pedunculis solitariis 1-floris axillaribus filiformibus folia subaequantibus ebracteolatis saepius reflexis, sepalis 3 mm. longis lineari-lanceolatis pubescentibus quam receptaculum longioribus, corollâ flavâ (vel albâ?) circ. 12 mm. longâ extus et intra tubum puberulâ, lobis ad apicem parvi-alatis duobus superioribus conspicue auriculatis, stylo 3-4 mm. longo glabro, indusii dorso pubescente ejusque apice breviter ciliolato, dissepimento fere apicem ovarii attingente, ovulis circ. 12 biserialibus, fructu non viso.

Cootanoorinna (between Warrina and Arkaringa Creek) coll. R. Helms, May, 1891; one specimen preserved in the Tate Herbarium. Very distinct in aspect, with its slender but rigid zigzag stems and thick linear distant usually curved stem-leaves. Perhaps nearest to *G. linifolia*, W. V. Fitzg. ex Krause, of North-West Australia, but differs in the much shorter stem-leaves, longer peduncles, glabrous style and procumbent habit.

G. Havilandii, Maiden et Betche nov. var. *pauperata*. Caulibus tantum 3-8 cm. longis, foliis radicalibus brevioribus angustioribus omnino vel fere integris, pedunculis axillaribus 5-10 mm. longis, dissepimento minuto crasso ad apicem piloso ut in typo.

Near Ooldea, coll. Daisy M. Bates. The same variety was collected by R. Helms in the Victoria Desert, W.A., 15th Sept. 1891, Camp 53.

Scaevola bursariifolia, n. sp. Frutex glaber, ramulis viscidis, foliis crassiusculis obovato-cuneatis vel oblanceolatis cum brevissimo petiolo 10-15 mm. longis approximatis sed non fasciculatis, floribus paucis solitariis axillaribus subsessilibus folia subaequantibus, pedunculo crasso 1-2 mm. longo duabus bracteolis linearibus quam receptaculum dimidio brevioribus instructo, sepalis rotundatis circ. ½ mm. longis, corollâ verisimiliter flavâ 8-9 mm. longâ extus glabrâ intus barbatâ, tubo lobis fere exalatis bis terque longiore, stylo glabro 4-5 mm. longo, indusii dorso pubescente, ovarii dissepimento tenui apicem non attingente, fructu ignoto.

Collected by Professor Ralph Tate in Feb. 1879 on the "Bunda Plateau," extending from north of Fowler's Bay along the Great Bight towards Eucla. Differs from *S. myrtifolia* (De Vriese) Krause in the viscid branchlets, smaller thicker obtuse leaves, shorter stout peduncles, smaller corolla with almost obsolete wings and shorter glabrous style.

GEOLOGICAL NOTES ON AN AREA ALONG THE NORTH-EASTERN MARGIN OF THE NORTH-EASTERN PORTION OF THE WILLOURAN RANGE.

By Douglas Mawson, Kt., D.Sc., F.R.S.

[Read October 13, 1927.]

These brief remarks are from field notes made in May, 1920, when on an inspection of copper prospects in the north-eastern portion of the Willouran Range. Howchin has published notes,(1) made during a visit in the year 1906, on the area immediately west and south-west of Marree. The observations now tendered refer particularly to the region further to the south and south-west, carrying the section into the high broken country of the Willouran Range proper.

Between Mundowdna and Marree the railway line traverses a plains country, little relieved by irregularities of the surface. Beyond, to the west and south-west, the Willouran Range can be seen from the passing train, standing out in bold relief as a jumble of hills culminating in Mount Willouran.

The less relieved country traversed by the railway line is occupied by a series of ancient rocks, for the most part constituted of slates. These will be referred to as the "Mundowdna Series." Rocks of this group can be noted outcropping a little to the east of Mundowdna Siding and following the railway line north for about three miles, when they pass beneath alluvial accumulations and later formations. To the west of Mundowdna, except for several patches covered by a surface mantle of Recent age, this slaty series continues for eight miles to the foothills of the Willouran Range. To the north it everywhere passes out of sight beneath the gibber-strewn plains before arriving at the latitude of Marree, where the underlying rocks are of Cretaceous age. This latter formation apparently junctions with the slate series several miles to the south of the township.

On the road from Marree to Mundowdna, at a point about one and a half miles from the former, was noted a flat-topped rise found to consist largely of a gypseous formation. This exhibits a bluff face to the north-west, and is otherwise of a build suggesting a possible former lake terrace. The following note was made at the time: "It seems to have been an old lake level. Town of Marree probably 50 feet below the level of the top of this terrace."

The low country between the railway line and the Willouran Range was traversed on a course almost due west of Mundowdna Siding. The Breaden's Hill copper mine, which lies N. 35° E. of Hogan's Well, and distant about one mile therefrom, was the first objective. The workings here are along a low rise which constitutes the western margin of the slaty region of small relief, and is at the same time the first decided physiographic element of the Willouran Range encountered west of Mundowdna. At this point there is an immediate and decided break in topography. To the west is the hilly country into which distinctly different types of rocks enter, and to which the term "Willouran Series" will be applied.

The Mundowdna Series.

In the intervening region of low relief to the east of Breaden's Hill mine, the underlying old rocks showed up at the surface at frequent intervals in belts

(1) "The Sturtian Tillite in the Willouran Ranges near Marree (Hergott) and in the North-eastern portion of the Flinders Range," by Professor W. Howchin, F.G.S. Reports Glac. Com., Sect. C, A.A.A.S., vol. xvii. (1924), pp. 67-76.

alternating with stretches obscured by drifted sands and alluvium. A wide belt of slates outcrops conspicuously in the middle zone of this belt. These dip at steep angles and strike in a nearly north and south direction, but exhibit a well-developed slaty cleavage directed approximately south-east to north-west. Over a considerable area in one part of the section, limonite pseudomorphs after pyrites cubes weather-out on the surface. Along some belts the slates cleave out perfectly into excellent slabs of even thickness as much as 9 feet in length.

On the western side of the main slate belt and about half-way across to Breaden's Hill is a strongly-defined outcrop of an interesting breccia dipping steeply to the west and seen to extend for miles to the north and to the south. This is a striking rock, composed for the most part of angular fragments, but several, obviously water-worn, quartzite pebbles up to 7 inches in length were noted. Fragments of a black slate are conspicuous and the matrix is calcareous. The hand-specimen collected is that of a gravel breccia, apparently water-laid, composed of fairly even-sized particles ranging about between ⅛-inch and ⅝-inch diameter. The components are diverse, though quartzite predominates. The interstitial filling is somewhat calcareous.

Travelling still further to the west, other similar bands but of finer texture were crossed. The intervening areas are evidently underlain by softer strata, for they are denuded and buried under alluvium.

These breccia belts are a feature of and are confined to the western side of the section under review, and culminate in a strong formation of much the same peculiar type along the eastern slopes of Breaden's Hill itself. In this latter locality the rock is in part of the nature of a semi-conglomerate, but elsewhere the included fragments are so slaty and angular as to constitute a true breccia. Amongst the included contents were recognised the following: quartzite, quartz grit, limestone, black slate, white sericitic slate, and light-coloured silicified slate. In a microscope slide prepared of a specimen from this locality is to be seen a fragment of a much-altered ophitic basic igneous rock, suggesting the possibility that it may have originated in a dyke located amongst the strata half a mile to the west. Quartzite predominates among the types represented, and a water-worn pebble of it, as much as 10 inches in length, was observed. The beds were here dipping to the east and trending, more or less, north and south down the face of the range.

There can be no doubt that the series just described occupying the low country between Mundowdna Siding and Breaden's Hill corresponds to that described by Howchin [(1)] as appearing further to the north extending over a few miles to the south-west and west of Boorloo Springs. The rocks of that area are described as slates, slates containing glaciated boulders, some quartzite, and on the western side bands of breccia with a calcareous base. These latter are evidently just such as appear in the vicinity and to the east of Breaden's Hill. In my section no quartzite occurred, nor was there observed any defined belt of glacial tillite or even slates carrying embedded boulders. But such beds may be there buried under alluvium, or if but poorly defined may have been missed for part of the section was traversed hastily in the evening in a failing light.

Nevertheless, though no characteristic glacial tillite was observed, it was noted at the time that some of the breccias and semi-conglomerates were likely to be of fluvio-glacial origin. In fact, these were entered in the field notes as "glacial breccias." Howchin [(1)] has suggested that this peculiar type of breccia may "have been formed along sheer planes with autoclastic effects, and include both the shales and the tillite."

There certainly has been faulting and dislocation of the sedimentary rocks along Breaden's Hill and to the west thereof. So it is possible that there has

been a downthrow of the country to the east occupied by the glacial series. But, though my examination was but cursory and not adequate for a proper study of the beds, I felt satisfied at the time that the formations in question were sedimentary breccias quite regularly interbedded in the series.

The Willouran Series.

The country to the west of Breaden's Hill is rugged in part, and this is due to one or more thick quartzite formations which stand out boldly. A traverse was made to the west in this belt for a distance of about four miles, and the formations encountered were briefly as follows:—

A massive quartzite formation of considerable thickness makes its appearance shortly to the west of Hogan's Well and occupies the high central country for a mile or two to the west. It strikes in a roughly north and south direction, directed towards Mount Willouran to the south, which prominence apparently owes its existence to the resistant character of this rock. This quartzite dips to the west on the eastern side and to the east on the western side, where the average angle is about 45°. It is, therefore, a north-and-south directed syncline, probably pitching to the south, for it appears to cut out on the line of strike to the north, and in its place are slaty and calcareous strata. There also appears to be a swinging of the strike in accordance with the assumption of a pitching syncline. In this arrangement the slaty and calcareous strata would underlie the strong quartzite which would be the highest in the succession of strata in the Willouran Series. This quartzite in its upper part is light-coloured, fine-grained, and dense. Under the microscope it is seen to be composed of even-sized grains and to be a purely fluvial type of sediment. Besides grains of quartz, there is present acid felspar amounting to about 10 per cent. of the volume, and clastic particles of certain accessory minerals, such as tourmaline. The indications are that this sediment was derived from pre-existing quartzites or from granitic rocks. Much of it is well laminated and ripple-marked faces are not uncommon.

Towards the base of the quartzite, nearing the underlying slates and approaching Hogan's Well, there are interbedded bands of a dark colour, which, seen in the distance, present the appearance of basalt sills. Microscopically examined they are seen to be argillaceous quartzites and dark-coloured greywackes. The quartz grains become noticeably less rounded and more splintery as the underlying series is approached. In this belt, between Hogan's Well and Breaden's Hill, are black slaty and calcareous rocks, and, in one place, the latter had been partly converted to a calc-silicate rock.

Another notable feature is the occurrence of a large ophitic dolerite sill in a calcareous slate series, beginning about quarter of a mile north-westerly of the north end of the Breaden's Hill mine workings, and extending for a great distance to the north-north-west. Where examined it was 40 yards wide and trended N. 23° W. The rock is epidotised and uralitized. It is quite like some of the basic igneous types of Wooltana and Blinman in the Flinders Range.

Ore Deposits.

To the westward from the crest of Breaden's Hill the rocks are seamed in various places with veins filled by quartz and carbonates. The latter are for the most part dolomite and siderite. Where these traverse the more calcareous strata they are richer in carbonates, but in siliceous slates and quartzite they are largely or entirely quartz. They are fillings from aqueous solutions that have risen along fracture lines. Where the walls are slate they are seen to be silicified and bleached, passing outwards into normal dark slate.

Splendid examples of this kind constitute what is known as Dun's mine, which is four miles to the westward of Breaden's Hill. There the country rock is a fissile, dark slate trending N. 60° W., and the lodes underlay for the most part to the westward. This slate, over a belt about 25 yards wide, is seamed with quartz veins, individually, from a few inches to a few feet in width. The lode material is rich in carbonates and carries copper ores and a trace of gold. Some portion of the main vein was originally capped by a manganiferous gossan. The abandoned workings are extensive and there is evidence that a considerable quantity of copper ore has been mined.

About half a mile east of Dun's mine is a long narrow siliceous vein traversing a slate formation. The outcrop carries iron and manganese oxides, also copper chloride, carbonate, and silicate. An assay for gold gave $1\frac{1}{2}$ dwts. per ton as its value.

Another cupriferous vein formation is located in black slates at Pissand Creek, just over two miles to the westward of Breaden's Hill. Again, two miles to the southward of this, copper stains appear over a considerable length in laminated quartzite. Yellow stains of volborthite are also in evidence.

At Breaden's Hill there is much evidence of prospecting activity in the past and a considerable tonnage of copper ore has evidently been won. The character of these copper-bearing formations varies considerably, but the dominant type is that of a combination of fissure veins and metasomatic replacement introduced into calcareous and siliceous sedimentary rocks which have been fissured and cracked by dynamic forces. The typical gangue minerals are earthy carbonates with more or less silica and iron oxide. The original metallic minerals were evidently pyrites and copper pyrites, but these are rarely to be seen in the workings, as the latter are almost entirely within the zone of oxidised ores. Atacamite, some grey sulphide and massive cuprite, usually embedded in dolomite or siderite, are distributed throughout. Native copper and malachite are also present. Secondary ore concentration has operated to a marked extent in the surface zone. In several of the outcrops and extending down to a depth of 6 or 8 feet characteristic yellow stains of a vanadate of copper and calcium were noted, developed as a product of weathering. This recalls the occurrence at Paul's mine in the Flinders Range to the south-east. Black slugs of atacamite are to be found weathered out lying loosely on the surface amongst the surface débris.

The various workings are not excavations serially arranged along one line of lode, but refer to many short and irregular outcrops which are, however, no doubt all more or less strung together horizontally or in depth. In the formation of the lodes, the copper-bearing solutions have invaded a cracked and folded rock system, and the result is the formation of many small and very irregular ore formations. A cut into the hill would thus be expected to meet repeated recurrences of lode matter. At the southern end of the workings this condition is particularly noticeable and, were the veins very rich, the proposition of quarrying the hill on one face would present itself as a method of mining applicable to the case. The assays, however, show that the grade of the lode matter is too low to warrant such procedure. The richest grade proved by assay over a width of 3 feet was 6 per cent. copper distributed in oxidised ores. Gold is present also, but usually only in traces, and never exceeding several pennyweights per ton of lode matter.

Roughly parallel, but a couple of hundred yards to the westward of the Breaden's Hill line of lode, and situated about half a mile to the south-westward, are other workings largely in a quartzite formation. Here veins of quartz and earthy carbonates are stained by copper chloride and vanadium. A portion of the ferruginous capping returned a gold value of $2\frac{1}{2}$ pennyweights per ton.

Summary.

The diversity of topography to the east and to the west of the line joining Breaden's Hill and Hogan's Well is also reflected in the rock strata contained within the respective areas. The Willouran Series is intruded by basic magma and is abundantly seamed with cupriferous mineral veins, which also are notable for the occasional presence therein of a little vanadium.

These facts are suggestive of two distinct ages, respectively, for the rock series. Further, many of the rock chips in the breccias of the Mundowdna Series closely resemble the black slates and quartzites of the Willouran Series. At the time of inspection I immediately assumed that they were unconformable series, but the visit was a hasty one, and it may be that certain of the phenomena noted, supporting the case for an unconformity, are to be explained by fracturing and dislocation of the strata, the effects of which are certainly in evidence.

As copper and vanadium are both associates of basic magma, it is likely that the mineral veins are genetically related to the basic magma and the period of activity responsible for the introduction of the basic igneous intrusion.

THE PARALANA HOT SPRING.

By Douglas Mawson, Kt., D.Sc., F.R.S.

[Read October 13, 1927.]

Plate XIX.

The Paralana Hot Spring.

The fact that the water is quite hot as it issues from the ground has caused much public interest in this spring. Such an occurrence is almost unique in this State, where igneous activity is practically a matter of the remote past. With the exception of the insignificant basaltic extrusions of Tertiary to Pleistocene age, on Kangaroo Island and at Mount Gambier, it seems almost certain that the igneous rocks of the State are not less recent than the Devonian. It is a matter of interest, therefore, to put on record what facts have been ascertained regarding the occurrence.

Topographic Features of the Area.

The spring water bubbles forth in the bed of a creek, referred to as "Hot Spring Creek," at a point about two miles to the north-westward of the homestead buildings of Paralana sheep station. At this point the high, rugged, mountainous country of the north-eastern Flinders Range gives way suddenly to a plains-region which extends away to the eastward. In an almost clear-cut line from the Hot Spring to the north-east, past Moolawatana head station, this sudden change in topography is discernable. It is, indeed, obviously a fault line with an immense downthrow to the east.

The rugged country, which has been referred to elsewhere as the "Mount Painter Complex," is constituted of an ancient series of metamorphosed sedimentary rocks and of igneous rocks, the latter predominating. These igneous rocks are principally granites, basic rocks being but little in evidence. It is doubtful whether any of the igneous elements in the series are of later age than the Cambrian. Rather widely distributed through this series are occurrences of uranium-bearing minerals such as fergusonite, monazite, autunite, torbernite, and uraniferous ilmenite. These are principally associated with a belt of potash-rich granite, some of which strikes across the country through the region of the Hot Spring. It is an interesting point as to whether the thermal condition of the spring water is due to the heating effect of radio-active disintegration of the unusually large content of uranium, thorium, and potassium in the rocks thereabouts.

Eastward of the north-east to south-west fault line are sedimentary beds composed of shales and sandstones with some pebble beds. These are slightly tilted, dipping about 5° in a direction ranging between east and north-east. At the mouth of the Yudanamutana gorge they are seen to rest upon a platform of red potash granite. Along the fault line they butt up against the Mount Painter Complex. This series of rocks has been referred to [1] by Woolnough as the Winton division of the Cretaceous. The surface rocks of this section exhibit marked silicification and residual gibbers are richly strewn over the surface. Jack

(1) "Preliminary note on the occurrence of large erratic blocks, probably of glacial origin, on the eastern escarpment of the Flinders Range, South Australia." A.A.S.A. Reports, vol. xvii. (1924), pp. 81-84.

and Ward,[2] from evidence supplied by boring operations, regard this area as underlain by the rocks of the great artesian water basin. They include Paralana Hot Spring within the artesian basin, but at the very edge thereof; the margin of the basin, thereabouts, is figured as following down the fault line from Moolawatana and swinging to the south-east at the Hot Spring. There can be no doubt, therefore, that the Jurassic-Cretaceous artesian basin does butt against the Flinders Range in this neighbourhood. It may well be, however, that the uppermost strata of this plains-area, leading to Lake Frome, are of Tertiary to Recent age overlying the Cretaceous. But this does not affect the present matter under consideration.

Examination of the rock formations in the neighbourhood of the Hot Spring revealed the fact that both the older and the newer rocks, though more particularly the latter, have been seriously altered over a zone of several hundred yards in width. The changes wrought in the rocks are so profound that it is sometimes difficult to discriminate what were originally Cretaceous sediments and what were igneous rocks. In general, the change has been a breaking-down of the silicates to kaolin and elsewhere a general silification. Immediately along the present line of exuding water is a vertical, reef-like belt rich in chalcedonic silica with occasional inclusions of iron pyrites. An assay of this "reef" formation was made for gold, but with a negative result.

This change in the neighbouring rocks is evidently to be ascribed to the rising hot waters, and the indications are that such waters formerly exuded at other spots in the locality. In fact, the extent of the belt affected by alteration suggests that, in former times, the hot spring waters were altogether more abundant.

From the Hot Spring, the junction of the older series and of the Cretaceous sediments runs away to the south-east, approximately, at right angles to the fault line from the north-east, to which reference has already been made. The topography suggests this may also be a line of fault, throwing down the Cretaceous rocks to the north.

The eastern entrance to the Yudanamutana gorge is close to, and immediately south of, the Hot Spring. The first section of the gorge proper, entering from this end, is determined by the existence thereabouts of a remarkable crush zone in the granitic rocks. This is evidently a great line of fault of ancient age. This line appears also to extend through the altered belt around the Hot Spring. In the other direction it makes for the locality of Mount Painter, which crush zone has been notably impregnated by solutions with depositions of silica, iron oxide, and uraniferous minerals.

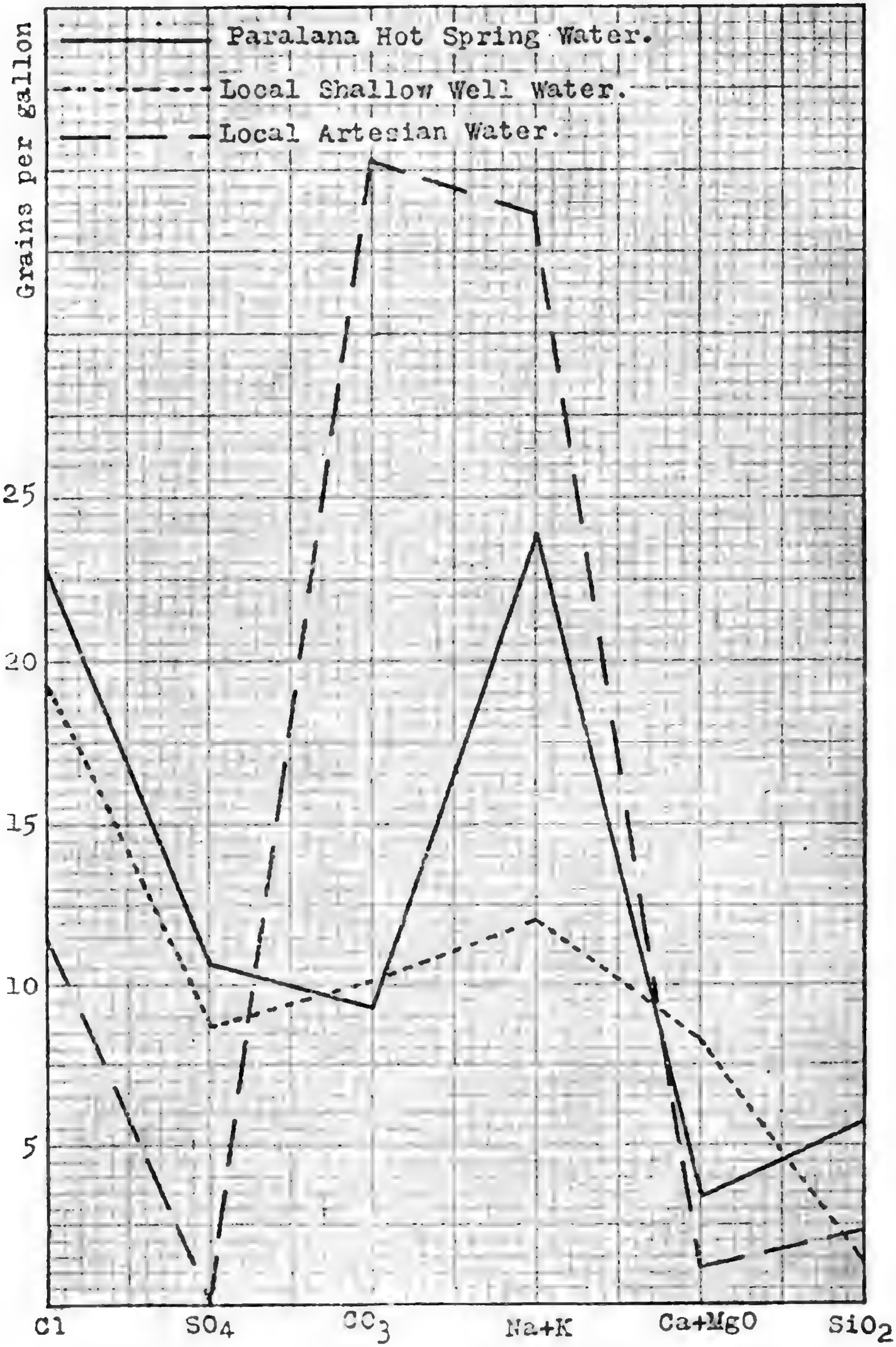
The location of the Hot Spring is, therefore, somewhat remarkable, being at the same time on a faulted margin of the Artesian Basin and on a crush zone extending through the chief radium-bearing belt of the Mount Painter Complex.

The Hot Spring.

The Hot Spring creek is one of a number of streams thereabouts, which rise in the ranges and flow through deeply-incised torrential courses to the plains. These are perfectly dry except during actual periods of rain, though in the case of the Hot Spring creek the spring maintains a certain amount of water in its bed for some distance below the outlet.

The water rises through fissures in the rock and through the sands of the bed of the stream, over a length of about 20 yards (pl. xix., fig. 1). The temperature

(2) "Some developments in shallow water areas in the north-east of South Australia." Geol. Survey of S. Austr., Bull. 11 (1925).


Paralana Hot Spring Water.
Local Shallow Well Water.
Local Artesian Water.
Grains per gallon
25
20
15
10
5
Cl
SO_4
CO_3
Na+K
Ca+MgO
SiO_2

is sufficient to kill small creatures such as frogs and crustaceans, the remains of which appear in the waters close to the source. Within a few yards down stream a growth of a kind of reed appears at the margins of the stream. A few yards further down a slimy, green algal growth, almost entirely covers the surface of the water. Much of this was dead and bleached at the time of our visit (pl. xix., fig. 2). In this section the water is still hot, but the temperature has fallen off appreciably.

Much of the water travels through the gravels and is not seen at the surface. At 300 yards below the spring a swampy area choked with reeds is maintained by the waters. The creek bed is then dry for a further quarter mile, when a pool about 100 yards or more in length is usually to be found. This pool rises and falls in an arbitrary fashion, evidently controlled by accessions through the underlying gravels. Below this point, the creek does not hold water except during periods of rain. There can be no doubt, therefore, that below this point at least the stream bed is traversing the region of newer sediments.

In November, 1924, the author, in company with R. G. Thomas, B.Sc., and A. R. Alderman, B.Sc., made an examination of the spring. The water was then issuing at a temperature of 144° F. An excavation of the sand to bed rock was made at one point on the line of issue, and the water escaping there gauged at 250 gallons per hour. But as this was only a portion of the escaping area, it was reckoned that the total volume of rising hot water would not be less than 1,000 gallons per hour.

The water is quite clear and of good drinking quality, as indicated by the analysis. Gas, in irregular, intermittent bursts of bubbles was escaping through the water at the outlet examined at the time of our visit. The quantity of the gas escaping at the orifice examined was judged to amount to between one-half and one litre per minute. Probably further gas was escaping into the gravels at other points along the line of issue. Great care was taken in securing and transporting to Adelaide for examination a sample of this gas, for it was hoped that it would be found rich in helium.

Unfortunately about two months elapsed before either the water or the gas could be tested for radio-activity, and when the test was made no appreciable activity was recorded.

Since that date, however, Dr. C. Fenton, who visited the spring early this year with a view to testing its therapeutic qualities, tested the gas on the spot for activity. He was able to record activity, but was not able to pursue the investigation on account of damage sustained by the electroscope. However, Dr. Fenton forwarded post haste to Adelaide a sample of the gas, which was examined by R. G. Thomas within a few days of despatch. Mr. Thomas found the gas to be highly active, the activity falling off gradually but not in accordance with the curve for radium emanation. He hopes to continue further with the investigation, for the curve of rate of decay of the emanation presents novel features.

Dr. W. T. Cooke undertook a chemical examination of the gas collected by us. He reported helium, if present at all, to be in not more than mere traces, whilst the presence of the gas neon is quite distinct.

Two miles away to the south-east of the Hot Spring is the Paralana homestead, and there, on the north side of the house, on sloping ground, two wells are excavated a few feet apart. These are only a few feet deep, but water rises in them to within a foot or two of the surface. Though so close together the water in one is clear, whilst in the other it is somewhat milky. A sample of the clearer water was taken for analysis, and the result appears under the title of "Homestead Spring." These are at a level close on 100 feet below that of the Hot Spring.

A further spring occurs on the rising ground above the level of the Homestead Spring, situated about half a mile to the south. This is referred to as "Back Spring" by the Paralana residents, but appears on the pastoral plan as "Black Spring." As there is nothing black about this spring, and as it is at the back of the station buildings, it is probable that the term "Back Spring" was the original one, and will be adopted here. Here, water slowly trickles away from boggy ground in the bed of a small watercourse. A sample of this water also was taken for examination.

In neither of these cases is the water hot, though it is rumoured that the Back Spring water may be 2° or 3° above normal. It is interesting to compare the composition of these waters with that of the Hot Spring as set out in the tabular statement herewith. These analyses were executed by Mr. W. T. Chapman, of the Assay Department, School of Mines:—

Analysis in Grains, per gallon.	Hot Spring.	Homestead Spring.	Back Spring.
Cl	22·83	29·50	30·59
SO_4	10·67	10·05	10·71
CO_3	9·30	10·05	10·05
Na	21·50	22·15	25·42
K	2·35	2·40	2·64
Ca	3·29	4·64	3·50
Mg	0·19	1·42	0·86
SiO	5·60	3·60	2·60
Total saline matter	75·73	83·81	86·37
Ditto, as ozs. per gallon ..	0·17	0·19	0·20
Assumed Composition of Salts.			
Calcium Carbonate	8·22	11·60	8·75
Calcium Sulphate	—	—	—
Calcium Chloride	—	—	—
Magnesium Carbonate ..	0·66	4·32	3·01
Magnesium Sulphate ..	—	0·95	—
Magnesium Chloride ..	—	—	—
Sodium Carbonate	6·89	—	4·68
Sodium Sulphate	15·78	13·74	15·84
Sodium Chloride	34·09	45·02	46·45
Potassium Chloride	4·49	4·58	5·04
Silica	5·60	3·60	2·60
Hardness (in degrees, English).			
Hardness, total	9·01	17·52	12·34
,, temporary ..	9·01	16·73	12·34
,, permanent ..	Nil	0·79	Nil
,, due to Calcium ..	8·22	11·60	8·75
,, due to Magnesium	0·79	5·92	3·59

There is a close parallelism in these analyses. That the Hot Spring is somewhat less saline may be explained by the fact that it has a much more abundant and rapid flow, whilst the others are stationary or sluggish, allowing of evaporation. That the Hot Spring is at a higher level than those at and near Paralana homestead is not incompatible with their all being controlled by the underground waters of the Artesian Basin, for there is a slight dip of the Artesian Basin beds from the Hot Spring towards Paralana station buildings.

The Source of the Hot Spring Water.

As the Hot Spring is on the faulted edge of the Cretaceous basin it seems likely that it is merely the escaping waters of the Artesian Basin. If so, it represents a temperature equivalent to that of waters of about 2,000 feet below the surface in the neighbouring area, as shown by the temperature of issuing waters from existing bores. An offset against this simple explanation is that waters naturally escaping from the Artesian Basin elsewhere do not ordinarily exhibit an abnormal temperature. However, Dr. L. K. Ward informs me that he found the temperature of one of the natural effluents at Dalhousie Springs to be about 118° F.

An alternative source for underground waters in the area between the Flinders Range and Lake Frome has been shown by Jack (2) to be that of shallow waters replenished by outflow from the ranges, which has entered the outcrops of the surrounding later formations which are for the most part certain beds of the Upper Cretaceous (Winton Series). These waters are, in general, comparatively fresh. For purposes of comparison the mean figures of three of the bore waters from the shallow water area of Wootana are quoted below. The cases chosen, namely, 1, 12, and 37 of Jack's report,(2) are such as have a total saline content approximating to that of the Hot Spring water:—

	Selected Wootana Shallow Wells.	Artesian Basin Water, selected Bores.
Cl	19·29	11·41
SO_4	8·70	0·12
CO_3	10·03	35·25
Na	12·01	11·95
K	—	1·72
Ca	4·71	0·95
Mg	3·57	0·21
SiO_2	1·40	2·45
Fe and Al Oxides	—	0·32
Total grains per gall. ..	59·71	84·36
Total hardness	26·81	3·23
Temporary hardness ..	16·72	3·23
Permanent hardness ..	10·08	—
Hardness due to Ca	11·77	2·36
Hardness due to Mg ..	15·03	0·87

The composition of normal Artesian Basin water of bores in that part of the basin is given also; these figures are the mean of analyses of waters from the Quartpot and Meteor bores. This is a carbonated type of water typical of that entering the Great Basin from the eastern margin and standard for the Artesian Basin in the area under discussion. Jack has shown that the waters of the Artesian Basin further to the west are sulphatic and not carbonated, due to the fact that the intake beds on that side of the basin are located in an arid region where the surface waters are, of course, all of that class. At Paralana the eastern carbonated type of water is to be expected in the main artesian supply, whilst the shallow waters percolated into the outcropping beds along the margin of the neighbouring ranges should be somewhat sulphated at least on account of the low annual rainfall of the locality.

A comparison of the Hot Spring water with that of the deep basin and of the shallow wells in the vicinity is best represented graphically (text fig.). This comparison of analyses does not point unequivocally to either the shallow or the deep waters as source, though it is clear that the water cannot be merely the eastern intake water of the Great Artesian Basin.

Fig. 1

Fig. 2.

Gillingham & Co. Limited, Printers, Adelaide.

The composition could easily be satisfied by assuming the spring to be of primary waters out of the older series of rocks, but there is no constituent in the water which is not in that of the Artesian Basin. Further, it occurs along the margin of the Artesian Basin, and not wholly within the old complex. In the absence of any definite feature limiting the source of the water to the older series, it must be regarded as partly or wholly a leakage from the deeper Artesian Basin. The sulphate content indicates contamination of the eastern intake waters with those of the arid western areas; this, it is assumed, is effected by commingling with the local shallow ground waters.

The thermal effect may be due to a rapid rise of the waters from the great depth along the fault line. Or the heat may be augmented by the probable existence of a high temperature gradient, locally arising from the abnormal accession of heat from radio-active disintegration.

A further source of heat in this locality would arise from the exothermic reaction entailed in the kaolinization of the highly-felspathic underlying granite. As already mentioned, such kaolinization has proceeded to a marked degree in the granite along the contact with the Cretaceous water-bearing beds.

DESCRIPTION OF PLATE XIX.

Fig. 1. The hot water is seen rising in a pool in the sands of Hot Springs Creek, and trickling away to the left picture. The stick is pointing to the spot where bubbles of gas are rising.

Fig. 2. The effluent stream of hot water at a point about 30 yards down stream from the source. A growth of reeds extends along the margins, from which extends inwards from both sides towards the centre a surface mat of green slimy alga, partly living and partly dead.

THE GEOLOGY OF THE WILLUNGA SCARP.

By C. T. Madigan, M.A., B.Sc.

[Read October 13, 1927.]

Plate XX.

The series of rock formations now known as the Adelaide Series has mainly been studied by Professor Howchin, in the type locality, the Mount Lofty Ranges in the neighbourhood of Adelaide, and his diagrammatic section from the River Torrens to the sea at Hallett's Cove is well known. This section shows a series from basal grits, resting on Archaeozoic rocks (Pre-Cambrian), through limestones, phyllites, quartzites, the Sturtian tillite and Tapley's Hill slates to the Brighton limestone, which group Howchin refers to the Lower Cambrian, but which is, perhaps, now more generally known by the uncontroversial title of the Adelaide Series, and above these and terminating with the sea coast, a short series of slates, quartzites, and a gritty limestone, of a general purple colour, referred to the Upper Cambrian by Howchin, and generally known as the "Purple Slates" Series. The whole has been considered a continuous thick series, for the lack of any obvious unconformities. The fossiliferous Cambrian beds are considered to overlie these purple slates, but to be cut out of the section and hidden by the waters of the gulf.

The nearest occurrence of fossiliferous Cambrian is at Sellick's Hill, in the Willunga Ranges, 12 miles to the southward of the Brighton limestone, at Noarlunga, and it seemed that here was a place worthy of further investigation with a view to obtaining more evidence as to the relationship of the fossiliferous Cambrian to the Adelaide Series, by working from the known to the unknown. The Adelaide Series along the north-western scarp of the Mount Lofty Ranges is much folded and faulted, and the relationship between the component beds themselves is very difficult to follow, so that details from a new area would also provide a valuable check on the accepted order of the series. With these objects in view a month has been spent in the field in the area, in camp at various points, and the ground thoroughly covered between Wickham's Hill in the north to Normanville in the south, an area about 24 miles long in a north-east and south-west direction, by four miles wide.

Plate xx. shows the results of the geological survey of this area. Topographically the region consists of the scarp of the Willunga Range, which trends north-east and south-west and terminates in the sea, south-westerly, at Carrickalinga Head. The area is bounded on the northern side, in part, by the Aldinga plain of recent alluvial outwash underlain by Tertiary deposits; and, in part, by the sea, at Aldinga Bay, at the south-westerly end. The southern boundary of the area at the north-eastern end is the boundary between the Hundreds of Willunga and Kuitpo, and further to the south-west the Hundred of Myponga is entered, where the Myponga-Yankalilla road forms the southern limit.

The southern boundary of the Hundred of Willunga follows the top of the watershed of the Willunga Range, from Wickham's Hill to Sellick's Hill, from whence it descends to the sea, but the watershed continues on into the Hundred of Myponga to Carrickalinga Head, being cut through in one place only by the deep course of the Myponga River. The scarp forms the northern side of this watershed with a fall of 700 feet in a mile and a half. It is deeply incised by watercourses, and but thinly mantled with soil, so that outcrops are frequent and formations easily followed. The top of the watershed averages about 700 feet

above the plain and gradually rises from 841 feet at Carrickalinga Hill, 1,094 feet at Mount Jeffcoat, 1,164 feet at Sellick's Hill, to 1,250 feet at Wickham's Hill.

On the northern side the drainage is all westerly, towards the sea. On the southern side of the watershed the fall is much less, and the drainage on this side is divided into two parts, in the depression running parallel to the range. At the north-eastern end, down as far as Victor Harbour road from Willunga, the country falls gently to the Meadows Creek, which flows south-westerly to near this point, where it swings easterly and joins the Finniss. The Victor Harbour road marks a slight divide in the depression. From it a creek flows south-westerly, almost in a straight line for 12 miles, parallel to the range, joining the Myponga River at Myponga, and, finally, cutting through the range into the sea at Myponga Jetty. The scarp is well established as a fault scarp with downthrow to the north (1), and the valley along the southern side probably represents another parallel fault line. This valley, throughout, is filled with recent alluvial and resorted Permian glacial sands, so that outcrops and exposures are few to the south of the watershed. Very little undisturbed fluvio-glacial deposits of Permian age occur in the area under review, so they have been neglected in the mapping. The chief occurrences are near Haycock Point (south of Carrickalinga Head) and in Section 715, Hundred of Myponga, where there are beds of white sands overlying buff-coloured sandstone on the highlands. Howchin recognised glacial deposits on the main road in this neighbourhood in 1897 (Trans. Roy. Soc. S. Austr., vol. xxi., p. 65).

Hundred of Willunga.

Work was begun from Sellick's Hill. The most conspicuous formations in this well-known section are the calcareous series containing the Archaeocyathinae beds, near the bottom of the hill, and three bands of white compact quartzite forming ridges across the hills, and causing the conspicuous kinks in the road. These formations were individually followed along the scarp till they disappeared successively beneath the alluvial of the outwash fans, never to appear again along the scarp, as was afterwards seen. These and all the other beds traced were found gradually to swing northerly in their strike, which is, in general, north-easterly, and thus to curve obliquely across the scarp and enter the plain. The Archaeocyathinae Series ends in the northern corner of Section 545, being last seen in two small creeks near their junction, in a wheat field at the foot of the scarp five miles from Sellick's Hill. The beds have here taken a decidedly northern trend, the strike being N. 34° E., and dip 50° S.E. The three quartzite beds outcrop higher up on the hillsides, with slates between them. The section below was run here up the hillsides across the strike.

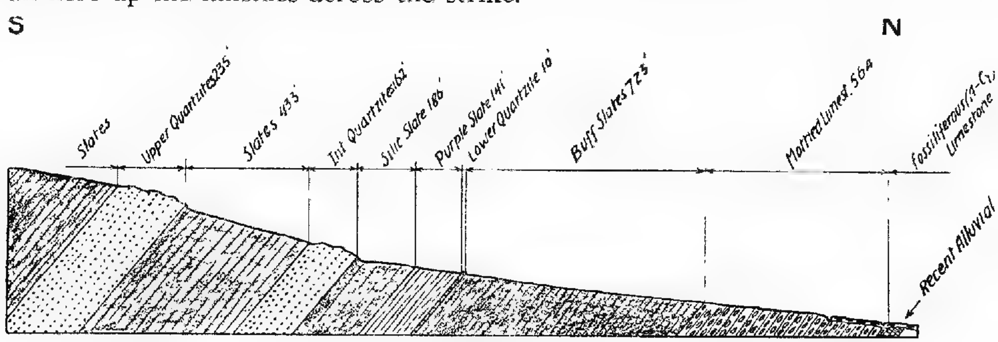


Fig. 1.

Section across the strike, showing beds above (?) the Archaeocyathinae limestone, with true thickness, at the end of the limestone outcrop, Section 545, Hundred of Willunga. Strike N. 34° E., dip 50° S.E.

The slate immediately above the lowest quartzite is a deep purple for a thickness of 141 feet, grading into a lighter-coloured siliceous slate, but below it there is a thickness of 723 feet of buff-coloured calcareous slates before the mottled limestone is entered. The two lower quartzites end in the plain a little further on, in Section 745. The lowest outcrop in this Section is seen in the creek in the south-westerly corner of the Section, where there is an exposure of soft purple slate for a thickness of 140 feet, obscured below beneath the alluvial, and giving way above to buff slates and then the quartz bands. The highest quartzite on Sellick's Hill, and the most conspicuous, ends in Section 303, near the old Colville homestead, at Willunga South.

Above these three quartzites, with the interbedded siliceous slates, lies a belt of somewhat arenaceous slate, about 900 feet thick, of homogeneous texture, without quartzite bands. It is seen at the upper end of the Sellick's Hill road, where it is banded and mottled in a variety of colours—red, purple, and yellow. It is well exposed in the creek in Section 276, Willunga South, where it is buff coloured in the lower parts, changing to a bluish slate with good cleavage in the upper. The dip is there only 30° S.E. In the description of the area, the term "upper" is used to indicate beds higher up the scarp. An upper bed does actually overlie a lower one, the dip being everywhere to the south-east, but the real stratigraphical position of the upper beds will be discussed later.

Above this thick slate comes a well-defined quartzite, which was traced from Section 578, Hundred of Willunga, along the deep creek in Section 750; across the two stone reserves in Section 746, in the northerly one of which there is a big quarry; through the quarry in the glebe, Willunga South; and the quarry in the road cutting on the road between Willunga and Willunga South, where the dip has flattened to 30° S.E.; on into a small quarry, in Section 703, where it ends. This quartzite maintains a very uniform thickness of 100 feet. In the quarry in the reserve, on the northern side of Section 746, it dips 35° S.E., strike N. 21° E., and in the quarry on the main road south of Willunga, 30° S.E., with a strike of N. 30° E. It is a fine-grained, rather porous, quartzite, with frequent well-defined narrow bands of coarser grit, a quarter of an inch or so wide and a half to one inch apart. This quartzite is the lowest bed of a very arenaceous belt 320 feet thick, ending in an upper, better-defined quartzite 60 feet thick. A good section of this arenaceous belt is shown in the creek in Section 755, Willunga South, which creek crosses the strike at right angles. Above these quartzose beds follows another 300 feet of bluish slates overlain by yet another quartzite bed. The creek, from Section 756, follows the strike of this quartzite on its eastern side, but turns north-westerly at right angles in the centre of Section 755, crossing the quartzite in a small waterfall.

Next come 600 feet of typical slates of good cleavage and purplish colour, followed by a dense limestone bed which in Section 755 is 18 feet wide. This limestone was considered to be the Archaeocyathinae limestone by Professor Howchin, who followed it from a point south of Willunga to near its termination, $2\frac{1}{4}$ miles north-easterly of Willunga. It is described in a postscript to his paper (2). He leaves a gap between the last appearance of the Archaeocyathinae Series, followed from Sellick's Hill to Section 545, and this limestone first encountered by him south of Willunga. The detailed mapping of the area shows the beds to be on quite different horizons. This limestone is easily traced south-westerly up to the cottage on the Hundred boundary in Section 751 by its continuous outcrop, and for some distance down the other side of the divide, where it can be followed by the red band of soil in the arable land, which marks its presence. It is then temporarily lost under the alluvium, to be picked up further along its line of strike in the Hundred of Myponga.

For the four miles from the top of the scarp almost to the bottom in Section 766, east of Willunga, the limestone is narrow and compact. Where it crosses the road up the scarp on the east side of Section 748, at the old church, it is 26 feet thick, a yellowish marble, dipping 60° S.E. In Section 756, below the Willunga Slate Quarry, now in operation, its width is 18 feet. It has been opened up in a small quarry here. The stone is a grey to dark-blue marble, shot through by white veins of calcite. Frequent pyrites crystals are a prominent feature.

Another small quarry has been opened in block 634, Willunga South, on the side of the road up to the old slate quarry. The thickness is here 25 feet and dip 50° S.E. The upper portion is dark-blue marble, the centre grey, and the lower yellow and dolomitic. Pyrites crystals are disseminated through it. The narrow bed continues north-easterly between the slates. In Section 306 it is 25 feet wide, pink, impure and dolomitic below, blue and compact above. In Section 766, on the south side of the creek, there is a widening out of the bed, which is largely obscured by a travertine covering. The slates above and below are very calcareous. The calcareous belt here appears to be about 150 feet wide. The limestone narrows down again on the north side of the creek.

Near the end of the outcrop, in Sections 520 and 305, the limestone widens out very considerably. Brown's Quarry is in Section 305, at Water Reserve No. 2, where there are good perennial springs. The quarry is opened to expose a thickness of 48 feet of solid limestone, with slaty walls. It is mainly a dense blue limestone, with a foot or two of pink marble below. Above, there is a further thickness of 240 feet of calcareous slates with frequent bands of purer limestone; and, below, calcareous slates extend for another 144 feet, giving a total thickness of 540 feet of calcareous beds. Pyrites is again a conspicuous feature of the limestone which is honeycombed in places by the weathering out of this mineral, or again reddened by its oxidation. The dip is 54° S.E., and strike N. 29° E.

The outcrop crosses the shoulder of the hill on the north-eastern side of Section 305, in a broad band 90 yards across, mainly marked by a travertine crust, but with many outcrops of marble. It has narrowed down again by the time the foothills road is met, where the last exposure is seen in some patches of marble showing through the soil of the unmade road. Half a mile further along the road, in Section 34, an extensive sheet of travertine and calcareous slate is exposed, indicating an upward extension of the calcareous beds.

Next above the limestone comes a great thickness of slates, 3,000 feet, in which the Willunga Quarries are situated. To the south of Willunga the dip of the beds increases as one goes up the scarp. The dip in the slates rises from 50° to 70° S.E. The best slate is in the centre of the belt, on which line all the quarries have been opened. There are no quartzites in all this 3,000 feet. The broad belt of slates is crossed by the Victor Harbour road as it mounts the scarp from Willunga. The upper limits of the formation are just below the Hundred boundary in the vicinity of Willunga, where a dense quartzite runs parallel to the boundary. This bed is seen in the quarry near the top of the Willunga Hill. Here it is 35 feet thick, with a dip 73° to the N.W. and strike N. 61° E. The stone is white, dense, coarse-grained, and of somewhat porous and mottled appearance, due to being felspathic, with the felspar grains either kaolinised or weathered right out. The outcrop can be followed for seven miles in a south-westerly direction, till it is lost in the alluvial near the road at the foot of the south side of Sellick's Hill. It crosses the divide in the south-western corner of Section 758. To the north-east it was traced for five miles. It curves down the scarp to a northerly strike and disappears in the foothills in Section 524. This quartzite ushers in a thick series of arenaceous beds, siliceous slates with numerous belts of coarse-grained felspathic and pyritic quartzites which occupy the whole of the scarp onwards to Wickham's Hill. It was at the northern extremity of the first

quartzite that the most important discovery was first made, in the more northerly of the two creeks crossing Section 562, and close to the north-western boundary fence of the Section, a few hundred yards behind the residence of Mr. J. McMurtrie. Here, immediately underlying the quartzite, tillite was found, a bed 150 feet wide across the strike, the rock bearing a striking resemblance to the tillite from the Sturt gorge. Small angular fragments and pebbles up to facetted stones 6 inches in diameter are embedded in a fine-grained matrix of bluish-green colour, weathering to buff in shallower zones. The boulders are here mainly of quartzite, white and somewhat coarse-grained, sometimes micaceous. The overlying quartzite contains a white, dense band about 10 feet thick, in laminae an inch wide. There are numerous small quarries in this band in the vicinity. The strike is here only a few degrees east of north. The tillite does not make such a bold outcrop as the quartzite, but may be traced in a south-westerly direction with the help of the quartzite. It narrows gradually, and finally pinches out in the slates in Section 33. As it dwindles it tends to leave the contact with the quartzite and enter the slates. The slates above and below the pebbly horizon are in many places banded in shades of blue, with some narrow coarse grit bands. The section below is exposed in the deep creek in Section 557, close to the road up the scarp.

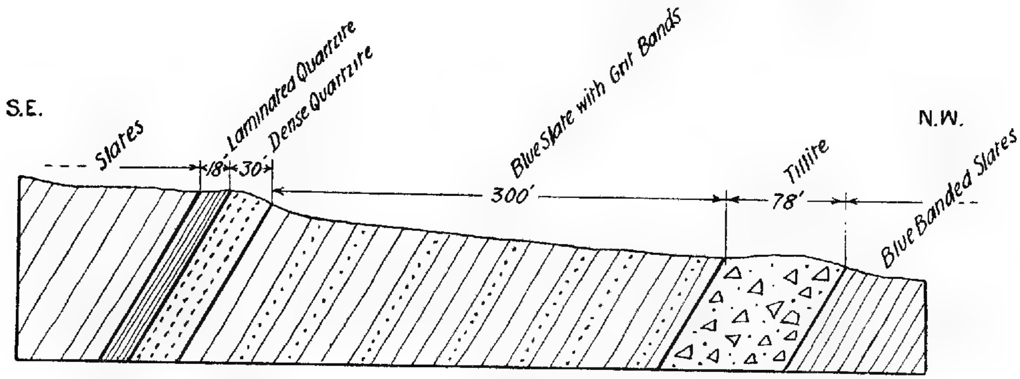


Fig. 2.
Sketch section showing beds associated with the tillite, Section 557, four miles north-east of Willunga.

The outcrop is here continuous for over a mile and a half, before it fades out in the slate, not to appear again till well down below the divide in the Hundred of Myponga, where there is an extensive development. The tillite is obviously a phase of the upper portion of the slates, which show indications of varve banding in many places, not only in juxtaposition with the tillite, but also where true tillite is absent. It could be expected to make and fade out along this horizon, which was found to be the case.

As mentioned above, next to the tillite comes a great thickness of quartzose sediments with many bands of quartzite. Several of the more important of these bands were followed and mapped in to show the trend of the country, but a detailed description of them would not serve any useful purpose at the present. On the map, the boundaries of the broader formations have been faithfully plotted, but in the case of the narrow ones, such as these quartzites and the narrow limestone, the position only is indicated by the symbol, the true width being too small to represent accurately on the scale used.

From the point on the scarp due east of McLaren Vale, about where the tillite disappears, and five miles north-easterly of Willunga, the dip of the beds flattens out to from 20° to 30°, and the strike becomes almost due north. Some of the

higher quartzites do not disappear beneath the plain, as the tillite does, but skirt round the scarp, and even rise again. Two such bands were followed from Section 565, where the dip is almost vertical, past Water Reserve No. 1, through a quarry in the west of Section 568, by which time the dip had decreased to 20°, and thence up the scarp towards the summit of Wickham's Hill, with a north-easterly trend again.

Thus, from Sellick's Hill to five miles north-easterly of Willunga, the beds cut across the face of the scarp at a small angle, and owing to their steep dip appear almost as straight lines on the map, little displaced by spurs and gullies, and swinging distinctly northwards at the foot of the scarp, but beyond this point, where the dip flattens out, the outcrops become much more winding, with the dips east to south-east. The scarp is becoming less conspicuous at Wickham's Hill, and beyond it the triangular Aldinga plain is drawing to its vertex, the floor rises, and the scarp is lost in a confusion of hills and valleys.

A good deal of the arenaceous series above the tillite is exposed in the cuttings of the new road up Wickham's Hill. At the foot of the hill the road is in slate. This slate is of greenish colour, thin-bedded, and more phyllitic than those below the tillite. They are somewhat calcareous at this point, and travertine up to a foot in thickness occurs on the surface in Sections 301 and 530. It is used for agricultural purposes. Towards the top of the hill two well-defined beds of quartzite occur, with shallow dip, and crossing the road at a low angle, so that the cutting gives long exposures of them. The lower one is 9 feet thick, and is a coarse grit of very even grain, somewhat friable, the grains being coated in places with ferric oxide, giving a bright mottled appearance. The upper quartzite is 12 feet thick and has been quarried for road metal near the top of the hill. The stone is coarse-grained and argillaceous in places, tending to a freestone similar in appearance to that of the Mount Lofty quarries. The associated slates are thin-bedded, flaggy, and siliceous. The quartzites vary very much in character when traced along their outcrop. On the road they are loosely cemented, but both north and south-west they become, in places, very dense and flinty, and sometimes remarkably highly pyritic. The lower one is particularly pyritic. Between these two belts of quartzite and the tillite there are several other quartzite beds, the more important being indicated on the map.

From the top of Wickham's Hill, along the watershed to a point some three miles south-westerly of the Willunga Hill, the country is very stony and poor and has never been cleared. Looking up at the scarp from the plain, the tree-line marks very clearly the upper limit of the slates and the beginning of the arenaceous series, on which the native vegetation is undisturbed. Towards Sellick's Hill the slates cross the divide and the country is cleared, and is good agricultural and grazing land.

Hundred of Myponga.

All the formations occurring in the area have now been mentioned in the above description of the scarp. From Sellick's Hill they may be traced in the Hundred of Myponga south-westward to the neighbourhood of Yankalilla. The coastal area has already been described in a former paper (3). Had the coastal sections only been run a little further inland, the tillite would have been met. The section south from Myponga Jetty stopped within a mile of the tillite, and that up Carrickalinga Creek within a hundred yards. The presence of tillite in the area was not then suspected, but Howchin subsequently noted an occurrence in a road cutting in Section 445, Hundred of Myponga (4), near the Carrickalinga Creek.

The thin limestone, and the quartzite overlying the tillite, in the Willunga scarp, were carefully traced into the Hundred of Myponga, and were discovered

outcropping in exactly the expected places wherever there were rock exposures. The quartzite, marked by the belt of scrub, crosses the watershed two miles southwestward of Willunga Hill, and again gives good exposures in the gullies on the southern side of the scarp, north of the Honeysuckle Flat road, and here the tillite is again well developed. The creek in Section 723 crosses the tillite just inside the northern boundary of the Section. The bed is here 130 feet thick, with a steep south-easterly dip. The rock again closely resembles the Sturtian tillite. Most of the boulders are of quartzite, but several of a decomposed quartz-felspar rock were noted, much quartz in a kaolinized matrix, seen in section to be an aplite. Quartzites and slates cross the gully between the tillite and the road, in scrub country, but above the tillite the land, overlying the slates, has once been tilled, and in it were noted indications of the limestone.

The next good tillite exposure is in the creek between Sections 550 and 721, the first creek east of the road on the southern side of Sellick's Hill, near Mr. Lowe's house. It occurs just above the quartzite, which is here white and flinty. The tillite is only exposed in the creek, but the ridge of quartzite makes a white band across the length of Section 721, and can be seen as one descends from Sellick's Hill. Between this quartzite and the Honeysuckle Flat road, four more dense quartzites cross the creek, from 10 to 30 feet thick, the first four close together, and the fifth somewhat separated and near the road.

Where the tillite and first quartzite should meet the road from Sellick's Hill, the small cuttings in the roadside disclose only a ferruginous gravel, containing many large and very smooth round boulders of pink quartzite. These appear to be Pleistocene gravels, possibly resorted Permian glacial material. Slates are seen crossing the road just above the point where the gravels come in.

The limestone next makes its appearance in the Myponga River, in Sections 628, 622, and 682, the river crossing it twice. The strike is here almost east and west, and the dip 60° southerly. The calcareous beds are 600 feet across. They are impure and banded with occasional bands of purer limestone. They are underlain by buff-coloured slates to the north, and overlain by grey slates to the south. To the south and west of this point, where the tillite would be expected, the country is covered with a mantle of Permian fluvio-glacial deposits, but two miles to the south-west, and half a mile northward of the main Yankalilla road, in the creek, in Section 91, the tillite makes the best exposure of all. It is here 150 feet thick. It is overlain on the downhill side by a 10-feet bed of dense blue quartzite, dipping at 35° S.S.E., followed by siliceous slates and quartzites, and overlain by 75 feet of rather less compact and somewhat felspathic quartzite, dipping at 50°, followed by a great thickness of slates. The accompanying section, from Myponga Jetty southwards, gives the complete succession from Archaeocyathinae limestone to the tillite.

The intermediate limestone is seen in the creek in Section 661, north side, near the boundary fence. It has here narrowed down again and become reduced to calcareous slates with a few bands of limestone.

The east-west road, passing just north of Carrickalinga Hill, is on the top of the watershed, and there are no exposures in its vicinity. The limestone cannot be traced across it, but its presence is shown to the southward by travertine and calcareous slates on the western side of Section 445, and in the Carrickalinga Creek, itself, calcareous slates are seen with a few feet of limestone bands, at the common boundary of Sections 1178 and 1179. The beds are here much crushed and squeezed together, and the tillite occurs in the creek only 300 yards above the limestone, at the road. The exposures are not good, and what is seen is poor in boulders. Better exposures are higher up the road in a cutting, at Howchin's locality.

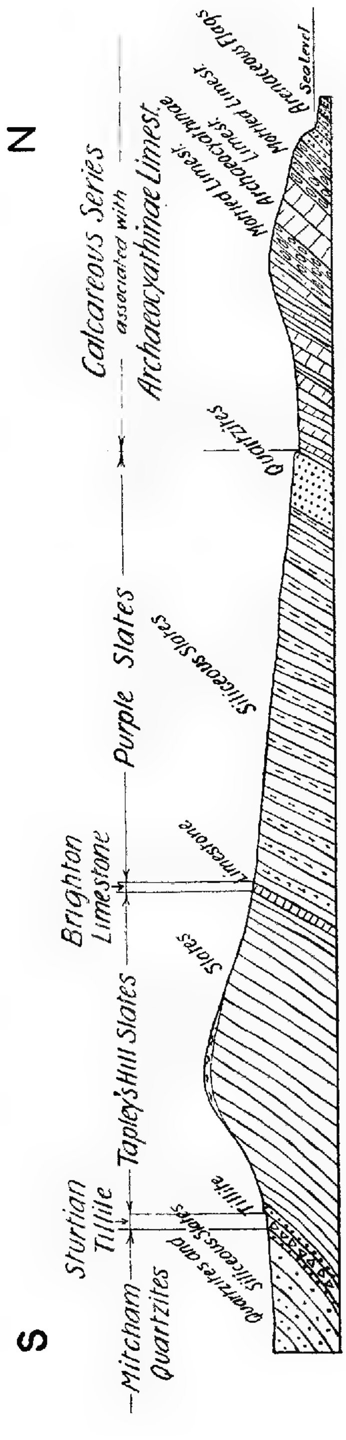


Fig. 3.
Section from Myponga Jetty southward for three and a half miles.

The new deviation of the Sellick's Hill road, which is marked on the map, gives another good section of the beds in the Archaeocyathinae zone. The three quartzites above the limestone may be traced to this road and across the deep gully to the west of it, where they cause a waterfall on the southern side of Section 275. They continue on to form Black Hill and Mount Jeffcoat, with the calcareous series to the north of them. The quartzites above them form the ridges between these points and the Myponga River to the south.

Discussion.

The geological map (pl. xx.) discloses a series of formations running through the area with remarkable continuity and parallelism. The absence of cross-faulting is notable. The succession from the north-eastern end is a group of phyllites, siliceous slates and quartzites, followed by tillite, then thick slates, limestone, another series of siliceous slates and quartzites, the calcareous series containing the Archaeocyathinae limestone, and arenaceous slates with nodules. This agrees exactly with the upper portion of the Adelaide Series, the first beds mentioned corresponding with the Mitcham and Glen Osmond quartzites and phyllites, then the Sturtian tillite, followed by the Tapley's Hill slates, the Brighton limestone, the purple slates, and the Archaeocyathinae limestone, thus confirming the order accepted in the Adelaide Series, and showing on the map the unbroken succession from each bed to the next.

The evidence is so strong that there is no hesitation in applying the Adelaide Series names to the hatched areas on the map. A few further points of resemblance between the beds may, however, be emphasised. The quartzites of the Wickham's Hill area are, in many places, dense, blue, and pyritic, identical with specimens from the Glen Osmond Quarries, and also from the quarries near Blackwood. The tillite, in the hand specimen, is indistinguishable from specimens from the Sturt Valley. Also, the tillite is striking north as it disappears under the plain in the Willunga scarp. Five miles to the northward, across the top of the Aldinga plain, the tillite is met again in the Onkaparinga Valley, where the succession through Tapley's Hill

slate, Brighton limestone, and purple slates as one goes towards the west, is the same (5).

The slates next the tillite are banded in colours, and resemble the ribbon slates of Tapley's Hill, in places, more particularly in contact with the tillite. The Willunga slate quarries occur in them, but they show little signs of ribbon structure in the horizon of the quarries.

The limestone agrees very closely with the Brighton limestone. In Brown's Quarry it is 45 feet thick, with pink limestone above and dense blue pyritic limestone below, followed by a considerable thickness of calcareous slates. Weathered boulders and exposed surfaces of this limestone were searched throughout the outcrop for traces of Archaeocyathinae, but none were found, nor were any indications shown in several microscope sections, though Howchin says (11) of this locality, "No fossils could be detected on examination of the stone by the naked eye, but subsequent treatment of the limestone, by sectioning and examination under the microscope, revealed the presence of Archaeocyathinae in a form that was of very open structure"; but the pink band was seen under the microscope to be composed of a mass of minute, beautifully even-sized, oolitic grains. This oolitic structure in the "pink limestone" of the Brighton limestones was noted as a special feature by Howchin, and with the thickness, occurrence of pyrites, etc., his description of the Brighton limestone (6) closely tallies with the occurrence in Brown's Quarry. The same features were noted throughout the Willunga scarp outcrop, but the thickness varied.

The series between the Brighton limestone and the Archaeocyathinae beds, referred to by the broad term of "purple slates," consists of half a dozen bands of quartzite in siliceous slates and shales. The slates vary a great deal in colour, being deep purple in some places, buff coloured in others, and again mottled, as seen near the top of Sellick's Hill. It is to be noted that caution must be used in assigning a colour to a slate. It is perhaps a less fixed characteristic than is generally supposed, in older formations, being surely very susceptible to change with varying chemical conditions of weathering in neighbouring areas over vast periods of time. Surprising lateral variations in colour were noted in the same beds in this series. In some places they were purple at the surface, in others bright yellow. Again, a bed described as yellow in one place may be found to be blue, green, or purple when seen at greater depth in a quarry or cutting.

However, in the series under discussion, there was a predominant purple note, and the beds were very similar to those exposed at Hallett's Cove and Ochre Cove, south of Port Noarlunga, at both of which places dense quartzites are associated with the slates, and, in fact, are as conspicuous as the slates.

The Archaeocyathinae beds need not be discussed further here.

Fig. 4 shows the series of beds occurring on the scarp, with the maximum thickness of each formation. The figure does not represent a section at any particular point.

Next comes the question of the stratigraphical order of succession. It is generally accepted as being that shown in the vertical column of fig. 4. The order of the formations is confirmed by the mapping of this area, but the mapping also emphasises a troublesome point frequently met with by all who have worked in the Mount Lofty Ranges. On a study of this area alone, the column would have been placed the other way up, with the Archaeocyathinae beds at the bottom. The dips on the scarp of the ranges from Sellick's Hill to the north-east are everywhere to the south-east, and this is a feature of the whole of the Mount Lofty Ranges, as noted by Woolnough (7) and R. L. Jack (unpublished section from Port Adelaide to Murray Bridge). It would be rank heresy to suggest that the

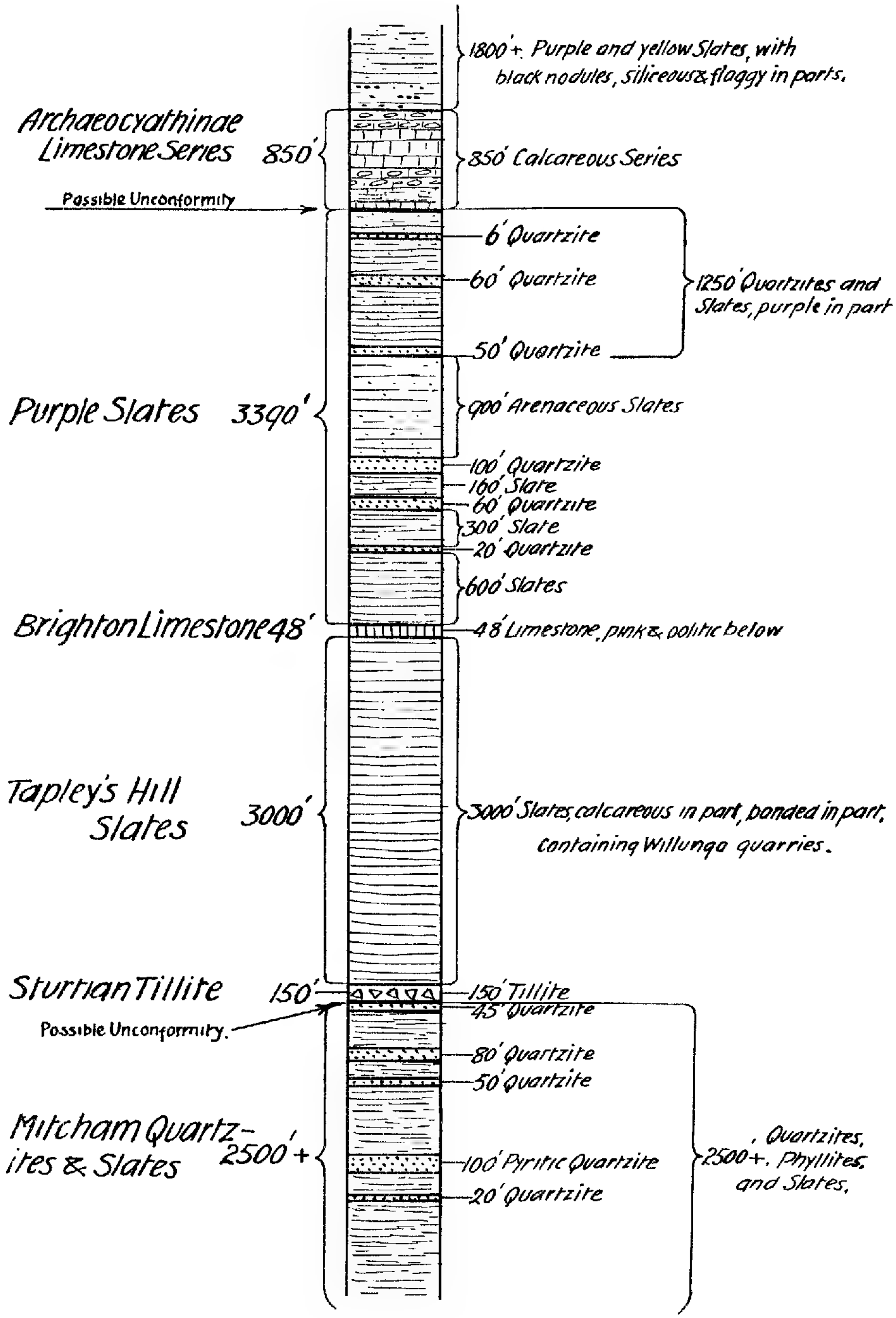


Fig. 4.
Table of strata represented along the Willunga scarp.

Sturtian tillite lies stratigraphically higher than the Archaeocyathinae limestone, so that its actual position there demands explanation. The position is aggravated in the Willunga scarp by the fact that as one goes north-easterly along the scarp, the dips become less, with the tillite changing from nearly vertical to nearly horizontal. The most obvious explanation is in reversal of dip, but this demands an almost complete overturning of the lower beds, not, of course, an impossible event. Howchin noted (8) that in the Onkaparinga section the tillite is seen overlying the Tapley's Hill slates, both dipping at the gentle angle of 20°, and he explains it as an overthrust.

It has been suggested that isoclinal folding has taken place between Sellick's Hill and Normanville. This is discounted by the non-repetition of beds, particularly in the case of the more easily recognised tillite and Archaeocyathinae limestone.

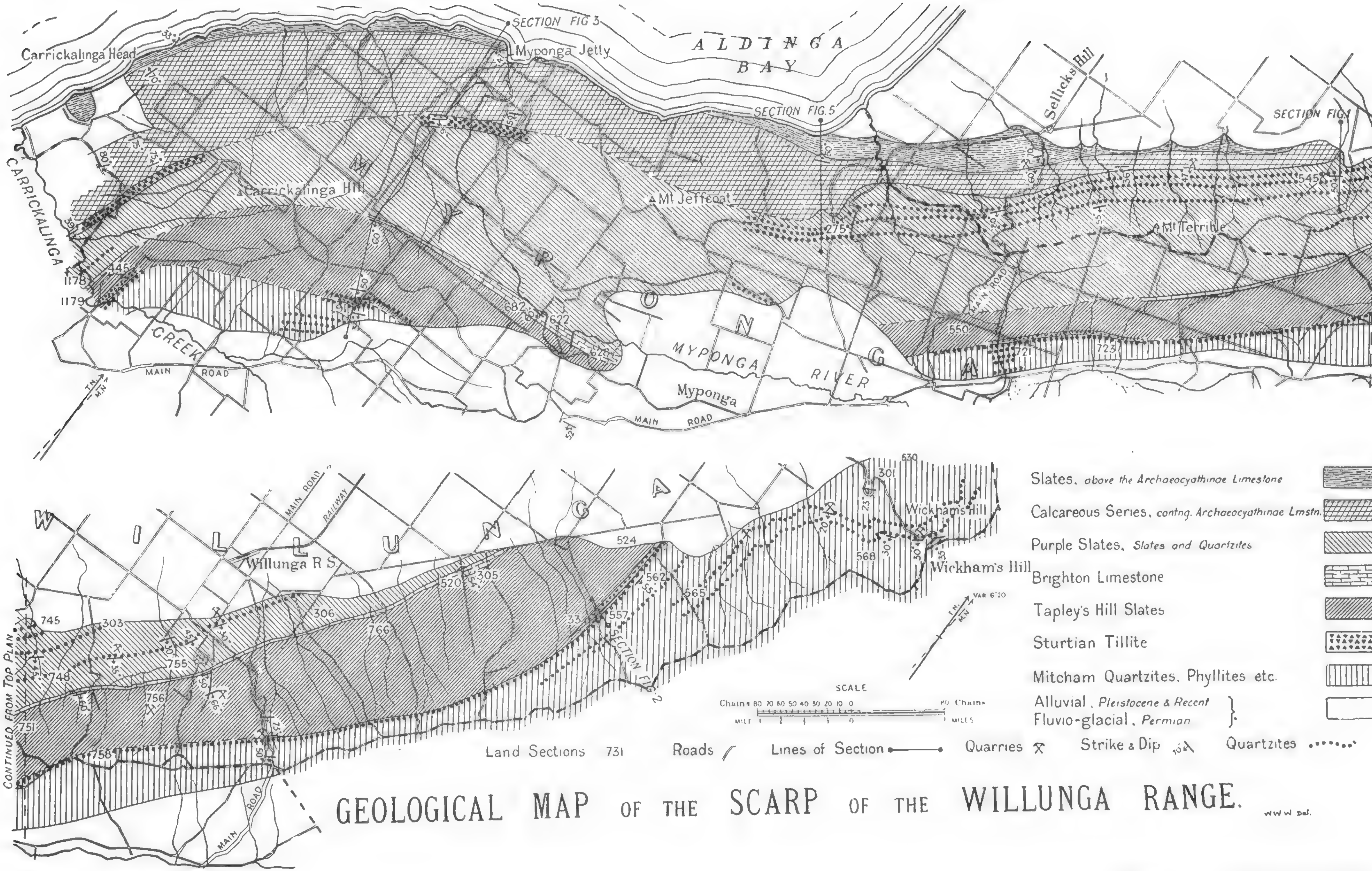
Selwyn (9) long ago suggested an anticlinal structure down the eastern coast of Gulf St. Vincent, pointing out that the coastal dips were westward, changing to eastward inland. This would also cause repetition of beds, unless the axis were exactly along the coast. From Sellick's Hill to Normanville it does look possible for the Archaeocyathinae limestone to form the axis of an anticline, but this would necessitate the beds inland forming the eastern limb of the anticline, the beds more remote from the coast, including the Sturtian tillite, overlying those nearer. One was inclined to this theory before the discovery of the tillite inland.

Westerly dips are noted along the coast at Hallett's Cove, at the end of the gully up which the Sellick's Hill deviation runs, and at Carrickalinga Head. At other points, notably Myponga Jetty, the dips are easterly. In a former paper (3) by the author, a section was given inland from Carrickalinga Head, and also up the Carrickalinga Creek (Nos. 3 and 4, pp. 200 and 201). The change over of dip is shown in these sections. Owing to the tillite occurring further inland, the westerly dip would now appear to be the normal, and the easterly the reversed, in opposition to the views expressed in that paper. Further, the slate with phosphatic nodules, which underlies the Archaeocyathinae limestone at Sellick's Hill, but overlies it further south, would appear to be definitely above the limestone. Annelid trails and borings described by the author (10) occur at this horizon at Myponga Jetty, and were formerly considered to be below the limestone.

The parallelism of the outcrops in the map is another important feature. There were no obvious unconformities noted in the whole area, and, in fact, no unconformities or disconformities have so far been postulated in the Adelaide Series. It is remarkable if none such exist in so thick a series, so diversified lithologically as to contain every class of sedimentary rock.

Two very likely places for disconformities are at the tillite and at the Archaeocyathinae limestone. In the Willunga scarp there is little evidence of any break in the neighbourhood of the tillite, but in the Onkaparinga there has been the over-thrust, and near Blackwood there is considerable disturbance, the quartzites below the tillite being very much folded and crushed, with herringbone structure in the slates. This was also noted below the tillite in the creek in Section 653, Hundred of Myponga. Several contacts between tillite and underlying beds in the railway cuttings above Eden suggest unconformities.

As to the Archaeocyathinae limestone, this, too, runs parallel in outcrop with the other formations in the area under review, but there is a suggestion of unconformity on the western side of the gully up which the Sellick's Hill deviation road runs. This is well viewed from the new road. The sketch section (fig. 5) represents the beds seen across the gully. The limestones show a monoclinal fold, with a general dip to the north-west, being almost horizontal in the centre and steeply inclined towards the sea. The underlying quartzites are almost vertical, and nowhere show a westerly dip, which is confined in all sections in this area



GEOLOGICAL MAP OF THE SCARP OF THE WILLUNGA RANGE.

Gillingham & Co. Limited, Printers, Adelaide.

to the limestone and higher beds. This particular section suggests the possibility of a very distinct unconformity between the Archaeocyathinae limestone of Middle Cambrian age, and the older Adelaide Series. In this case it is not impossible that the order of beds in the upper part of the Adelaide Series, the tillite, Tapley's Hill slates, Brighton limestone, and purple slates and quartzites, might be correctly reversed, with the purple slates and quartzites (arkose in places) at the base. This would at least satisfy the demands of the dips in this area, and also in the upper part of the Onkaparinga section.

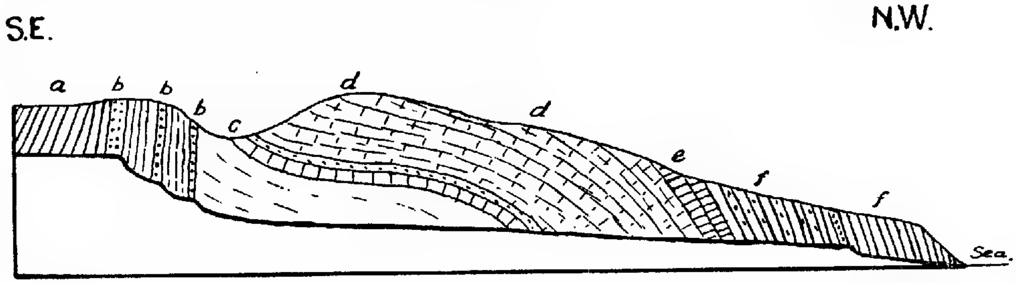


Fig. 5.

Sketch of west side of gully, Sellick's Hill deviation road, one and a half miles: a, purple slates, banded; b, quartzites; c, dolomitic limestone, uppermost in Sellick's Hill road section; d, impure and slaty limestone, weathering to yellow clay in many parts; e, Archaeocyathinae limestone; f, slates, siliceous in part, purple and yellow, with black nodules.

List of References.

1. Howchin, W., Trans. Roy. Soc. S. Austr., vol. xxxv., 1911, p. 55.
2. Howchin, W., Trans. Roy. Soc. S. Austr., vol. xxi., 1897, p. 85.
3. Madigan, C. T., Trans. Roy. Soc. S. Austr., vol. xlix., 1925, p. 198, *et seq.*
4. Howchin, W., Trans. Roy. Soc. S. Austr., vol. l., 1926, p. 97.
5. Howchin, W., Trans. Roy. Soc. S. Austr., vol. xxviii., 1904, p. 269, *et seq.*
6. Howchin, W., *Ibid*, p. 262.
7. Woolnough, W. G., Trans. Roy. Soc. S. Austr., vol. xxxii., 1908.
8. Howchin, W., Trans. Roy. Soc. S. Austr., vol. xxviii., 1904, p. 278.
9. Selwyn, A. R. C., Geological Notes, S. Austr. Parl. Paper, No. 20, 1860.
10. Madigan, C. T., Trans. Roy. Soc. S. Austr., vol. l., 1926, p. 31.
11. Howchin, W., Trans. Roy. Soc. S. Austr., vol. xlix., 1925, p. 3.

NOTE ON THE GEOLOGICAL HORIZON OF THE ARCHAEOCYATHINAE.

By Professor T. W. Edgeworth David, K.B.E., D.S.O., D.Sc., F.R.S., etc.

[Read August 11, 1927.]

I. Introduction.

The following short note is written with a view to at once modify an opinion which the author has expressed to this Society in a previous paper.(1) It is not intended to anticipate the detailed discussion of the whole subject which will appear in the chapter on the Cambrian rocks of Australia by the author in collaboration with Dr. F. W. Whitehouse, in his book on the Geology of the Commonwealth; but as some time may yet elapse before that work is published, the author considers that in fairness to his colleague, Professor Howchin, he should forthwith place on record some of his reasons for a change of opinion which brings the author's views into a close accord with the earlier views of Professor Howchin.

The special point herein discussed is that of the geological horizons throughout the world of the *Archaeocyathinae*, that wonderful and mysterious group of organisms, which formed the first analogues of the modern coral reef, and has nowhere any finer representatives than in the magnificent reefs of South Australia.

The gist of this note is in the table and diagram which the author has compiled from all the sources available to him, though it is still far from being complete.

An earlier table of this kind was published through this Society by Professor T. Griffith Taylor,(2) in his valuable memoir on the *Archaeocyathinae*, to which since its publication in 1910 palaeontologists have added but little. The list, however, as given by Taylor, has now been somewhat extended by the author, and an attempt made to define the horizon of the *Archaeocyathinae* in various areas where they occur as precisely as possible.

II. The Table and Diagram.

These show that the oldest known horizon of the *Archaeocyathinae* is on the western side of the United States of America, in Eastern California at Silver Canyon, Inyo County, California. The Californian reefs are 100 feet in thickness, and are associated with such primitive types of trilobites as *Holmia rowei* and *Holmia weeksi*.

Walcott (3) states, as follows, in regard to the exact age of the *Archaeocyathinae* reefs of Silver Canyon, White Mountain Range of Inyo County, California:—"Just what its relations to the *Olenellus* fauna of Central Nevada and British Columbia are I am at present unable to state, except that I believe it to be older than the *Olenellus* fauna of Central Nevada."

In another passage (4) he states:—"One of them [the trilobites *Holmia rowei* and *Holmia weeksi*, Walcott, T. W. E. D.] is more primitive than such forms as *Olenellus thompsoni*, Hall, and *Holmia bröggeri*, Walcott, of the upper portions of the Lower Cambrian Section."

(1) "Occurrence of Remains of Small Crustacea in the Proterozoic (?) or Lower Cambrian (?) Rocks of Reynella, near Adelaide." Trans. Roy. Soc. S. Austr., vol. xlvi., 1922, pp. 6-8.

(2) "The *Archaeocyathinae* from the Cambrian of South Australia." Mem. Roy. Soc. S. Austr., vol. ii., pt. 2, p. 68.

(3) Walcott, C. D., "Lower Cambrian Rocks in Eastern California." Amer. Jour. Sci., Ser. 3, xlix., pp. 141-144, 1895.

(4) Journ. of Geology, 17, 1909, p. 198.

Locality.	California Inyo Co.	Nevada, Waucobia, Barrell Springs, Silver Peak.	New York, Troy.	Labrador, Strait of Belle Isle.	Scotland.	France, Normandy, Carteret (in Cotenton).	Pyrenees, Montaigne Noire.	Sardinia, Canal Grande.	Siberia, Torgoschino or Yenisei.	India, Spiti.	China, Wutai.	Australia.			Antarctica.	
												Kimberley.	Templeton River.	South Australia.		
Geological Horizon.				Anseau Loup.												
MIDDLE CAMBRIAN					*Archaeoscyphia* (not *Archaeocyathinae*) in Durness Limestone, dolomitic and cherty, passing down into grits and quartzite, with	*Cryptozoa* (?) *Ptychoparia* *Opisthoparia* (?) *Archaeocyathinae* cf. *Spirocyathus* „ *Protopharetra* „ *Ethmophyllum* „ *Archaeocyathus*	*Paradoxides rugulosus* (Corda) *Conocephalites coronatus*, Barr *Ptychoparia rouairouxi*	Fragments of *Archaeocyathinae* *Paradoxides rugulosus* (Corda) *Sao Sarda* *Anomocare* *Epiphytum flabellatum* *Siphonema incrustans* (= *Girvanella*)	*Liostracus maydelli* } Wilni *Anomocare rawlowski* } *Agnostus czekanowskii*, Olenek	*Zacanthoides* and *Oryctocephalus, Coscinocyathus* cf. *corbicula*, Bornemann	*Dorypyge richthofeni laevis* *Agraulos* *Anomocare* *Ptychoparia* (8 species) *Coscinocyathus elvira*	*Girvanella* *Salterella hardmani* *Ptychoparia*	*Agnostus* *Ptychoparia* *Bathyuriscus*	*Ptychoparia australis* (?)		
PASSAGE BEDS					*Salterella* beds at base,		*Archaeocyathinae* *Archaeocyathus*	*Archaeocyathinae* Reefs with *Ptychoparia* and *Olenopsis zoppii*	*Archaeocyathinae* reefs with *Dorypyge* and *Olenellus* (*Olenopsis*) *kjerulfi* } Torgoschino						*Epiphyton fasciculatum* *Epiphyton grande* *Archaeocyathinae*	Typical Fossils near to or associated with the *Archaeocyathinae* horizon
LOWER CAMBRIAN	Reef 100 feet thick *Protopharetra* *Coscinocyathus* *Archaeocyathus* *Olenellus* sp.	*Archaeocyathus atlanticus* *Ethmophyllum whitneyi* *Olenellus gilberti* *Holmia rowei* *Holmia meeksi*	*Ethmophyllum rarum* *Ethmophyllum rensslaericum* *Olenellus asaphoides*	*Ethmophyllum profundum* *Archaeocyathus atlanticus* *Olenellus thompsoni* *Salterella pulchella* *Salterella rugosa*	and *Olenellus* = "Serpulite grit," "Fucoid Beds" Dolomitic shale, limestone, and mudstone with *Olenellus*		*Coscinocyathus*, etc.	And *Palaeospongia*		*Redlichia*		*Redlichia* and forms allied to *Mesonacis*	*Redlichia* (?)	*Redlichia pritchardi*. *Redlichia theilei*, Chapman *Archaeocyathinae*		

GEOLOGICAL HORIZON OF *ARCHAEOCYATHINAE* SHOWN DIAGRAMMATICALLY.

He adds that this primitive Cambrian fauna is some 5,000 feet lower in the series than the *Olenellus* fauna proper. This appears to be the oldest horizon to which the *Archaeocyathinae* have as yet been traced in any part of the world.

These oldest Cambrian reefs contain *Ethmophyllum whitneyi*, Meek, in great abundance; also *Protopharetra, Coscinocyathus, and Archaeocyathus (?).*

At Silver Peak, Nevada, *Archaeocyathus* and *Ethmophyllum* are associated with *Olenellus gilberti*, and are considered by Walcott to belong to the base of the Middle Cambrian or top of the Lower Cambrian.

At Troy, New York, *Ethmophyllum* is associated with *Olenellus thompsoni* as well as at Anse au Loup in the Strait of Belle Isle.

It may be observed that, as has already been suggested by Professor T. Griffith Taylor,[5] no true *Archaeocyathinae* originally recorded from the Cambrian Durness limestones of Scotland have ever really been found there, the forms mistaken for *Archaeocyathinae* being really referable to sponges, like *Archaeoscyphia*. Lately, Bigot [6] has recorded *Archaeocyathinae* in a preliminary note, from Carteret in the Cotentin in Normandy, France.

The forms of *Archaeocyathinae* present seem allied to *Spirocyathus atlanticus*, Billings, to *Protopharetra, Archaeocyathus*, and *Ethmophyllum*. The trilobites, not yet described in detail, appear to belong mostly to the genus *Ptychoparia*. Possibly *Opisthoparia* is represented.

There are also present fossils figured by Bigot, remarkably like the so-called *Cryptozoa* collected by Dr. C. Chewings from the Macdonnell Ranges described and figured by Howchin,[7] and those from Italowie Creek, in the N.E. Flinders Ranges, figured and described by Mawson.[8]

In the Pyrenees, Bergeron has described *Archaeocyathus* and *Coscinocyathus* as occurring in Montaigne Noire in a limestone underlying the *Paradoxides rugulosus* zone of the Middle Cambrian. The *Archaeocyathinae* belong there, in his opinion, to the Georgian (Lower Cambrian) rather than to the Acadian (Middle Cambrian) zone. At the same time they appear to be near the passage beds from Middle to Lower Cambrian.

In Spain, in the Province of Seville, *Ethmophyllum marianum*, Roemer, has been recorded from El Pedroso by Macpherson.[9] Hernandez-Pacheco records *Archaeocyathus, Ethmophyllum, Dictyocyathus, Coscinocyathus*, and *Protopharetra*.

The stratigraphical evidence there is not yet very clear, but the *Paradoxides rugulosus* zone is represented in places in Spain, and the *Archaeocyathinae* horizon is, presumably, below it.

In Sardinia, the *Archaeocyathinae* is described in the classic work of Bornemann.[10]

---

(5) "The *Archaeocyathinae* from the Cambrian of South Australia." Mem. Roy. Soc. S. Austr., vol. ii., pt. 2, footnote to p. 69.

(6) Bigot, A., "Sur le Cambrien de l'Est du Massif armoricain." Bull. de la Soc. Linn. de Normandie, 7 Séries, i.-viii., Caen 1925, pp. 93-113, pl. iii., and *ibid*, pp. 136-144, pls. iv.-viii. "Sur les Calcaires Cambriens de la Région de Carteret et leur Faune."

(7) Howchin, Professor Walter, "The Occurrence of the genus *Cryptozoön* in the (?) Cambrian of Australia." Trans. Roy. Soc. S. Austr., vol. xxxviii., pp. 1-10, pls. i.-v.

(8) Mawson, Sir Douglas, "Evidence and Indications of Algal Contributions in the Cambrian and Pre-Cambrian Limestones of South Australia." Trans. Roy. Soc. S. Austr., vol. xlix., pp. 186-190, pls. xiii.-xv.

(9) Macpherson, J., "Sobre la existencia de la Fauna primordial en la Provincia de Sevilla." Anal. de la Soc. Espan. de Hist. Nat. Tomo., vii., 1878, pp. 280-284, and also N. Jahr., 1879, p. 930. See also Hernandez-Pacheco, E. La Sierra Morena y la Llanura Bética. (Sinthesis Geologica), xiv., Congreso Geologico International, Madrid, 1926.

(10) Bornemann, Dr. J. G., "Die Versteinerungen des Cambrischen Schichtsystems der Insel Sardinien." Nova Acta der Ksl. Leop-Carol. Deutsch Akad. der Naturforscher. Band li., Nr. 1., pp. 1-84, pls. i.-xxxiii.

The *Archaeocyathinae* reefs there overlie conformably strata containing the trilobite *Olenopsis zoppii*, Born., and appear to be below the *Paradoxides rugulosus* zone (middle of Middle Cambrian) of that island.

Walcott [11] considers that *Olenopsis* occurs "either in passage beds from the Lower to the Middle Cambrian or in the Upper beds of the Lower Cambrian." . . . "*Olenopsis* is below the horizon of the Middle Cambrian in Pennsylvania," and it is "in the passage beds at the base of the Middle Cambrian in Montana, Alberta, and British Columbia."

At Torgoschino, near Krasnoiarsk, on the Yenesei River, in Siberia, von Toll's [12] important memoir concludes *(op. cit.*, p. 54) that these *Archaeocyathinae* limestones (which he regarded as of algal origin) are not older than the zone of *Olenellus kjerulfi*, and probably not younger than the zone of *Paradoxides oelandicus*. That is, their zone is near the passage beds between Lower and Middle Cambrian.

In India one form only of the *Archaeocyathinae* has as yet been found, a *Coscinocyathus*.[13]

Reed describes *Coscinocyathus* cf. *corbicula*, Born., from his (Reed's) horizon No. 2, which he considers belongs to the lower stage of the Middle Cambrian. Associated with the *Coscinocyathus* are the trilobites *Zacanthoides, Oryctocephalus, Microdiscus griesbachi*, and *Ptychoparia; Coscinocyathus* cf. *corbicula*, is comparable *(op. cit.*, p. 64) with a form occurring in Sardinia, and probably in Siberia. *Zacanthoides (op. cit.*, p. 9) appears to be characteristic of and restricted to the Middle Cambrian, and has previously only been recorded from America. *Z. indicus*, Reed, occurs on the Parahio River Valley, Spiti.

Oryctocephalus salteri, Reed, *Oryctocephalus*, has been referred to the *Olenidae*. It occurs in the Middle Cambrian of Mount Stephen, British Columbia, and from a similar horizon in Nevada, that is Middle Cambrian.

In India one form only attributed to the *Archaeocyathinae* has been recorded by F. R. Cowper Reed.[14]

In China also a *Coscinocyathus (C. elvira)* has been signalled by Walcott.[15] This occurs just above the top of the Man-t'o formation containing the trilobite *Redlichia*, and therefore of Lower Cambrian age. In China, therefore, *Coscinocyathus* is Middle Cambrian.

The geological horizon of the *Archaeocyathinae* of Antarctica is not yet known. In Australia it is doubtful whether the *Archaeocyathinae* have been definitely identified in the Kimberley, or Northern Territory, or North-west Queensland areas. It is not proposed here to discuss the Australian literature dealing with the *Archaeocyathinae*. The whole subject of the Australian Cambrian fauna is being reviewed by F. Chapman, and particularly by Dr. F. W. Whitehouse; but it is clear from the evidence of the age of the *Archaeocyathinae* in general throughout the world, and also from the nature of the trilobites immediately and conformably overlying the *Archaeocyathinae*, that if the *Archaeocyathinae* of South Australia go down into the Lower Cambrian at all, they only descend into the top portion of that formation. There should, therefore, be room for perhaps many thousands of feet of strata below the base of the *Archaeocyathinae* limestones of South Australia before the true base of the Lower Cambrian series is reached.

(11) Journ. of Geol., 17, 1909, p. 240.

(12) Toll, E. von, "Beiträge zur Kenntniss des Sibirischen Cambrium." Mem. Acad. Imp. des Sci. St. Petersburg, vol. viii. (Ser. viii.), 1898, pp. 1-57, pls. i.-viii.

(13) Reed, F. R. Cowper, "Himalayan Fossils—The Cambrian Fossils of Spiti." Pal. Indica, Ser. xv., vol. vii., Mem. No. 1, 1910, p. 58, pl. vi., fig. 33.

(14) Reed, F. R. C., "Himalayan Fossils—Cambrian Fossils of Spiti." Pal. Ind., Ser. xv., vol. vii., Mem. No. 1, 1910, pp. 1-70, pls. i.-vi.

(15) Walcott, C. D., "Cambrian Faunas of China." Proc. U.S.A. Nat. Mus., vol. 29, 1908, pp. 1-106, and *ibid*, vol. 30, 1906, pp. 563-595.

This accords with the views originally put forward and so consistently adhered to by Professor Howchin, *viz.*, that the whole of what the author has termed the Adelaide Series, comprising some 10,000 feet or more of strata (including the glacial stages), may be of Lower Cambrian age, rather than late Proterozoic. At the same time, it would not necessarily follow that there is an entire absence of Proterozoic strata in the Flinders Ranges.

Mawson [16] has recorded a distinct unconformity below the Sturtian glacial series at Yudnamutana, a considerable thickness of sedimentary rocks intervening between these basal conglomerates marking the unconformity and the basal crystalline series of quartz-porphyries, etc. The locality is Bolla-Bolama Gorge. It is, however, possible that this unconformity may mark the coming in of a belt of Ordivician rock similar to that which is developed in the Macdonald Ranges (?). Dr. L. K. Ward [17] has suggested the probability of such an occurrence.

Again, Mawson [18] suggests a slight break above the Wooltana volcanic series, but concludes that no considerable erosion interval separated the volcanic period from the ice age. A slight difficulty in the way of at once placing the whole of the Adelaide Series in the Lower Cambrian is that if, as according to both Professor Howchin and C. T. Madigan, [19] the ilmenitic grits, near Yankalilla Gorge, are of Cambrian age, and Madigan's view is correct, that there is a conformable upward sequence into the mica schists (which are intersected by the Monazite-bearing pegmatite, close by), the geological age of which, as deduced by R. G. Thomas,[20] and interpreted by Dr. Arthur Holmes, is indicated at about 840 millions of years; the age is somewhat too great for Cambrian, the downward limit of which is fixed as about 600 millions of years.

Summary.

1. The *Archaeocyathinae* limestones of the world, with the exception of those of Western North America, occur either at the top of the Lower Cambrian or at the base of the Middle Cambrian. Only in the case of *Coscinocyathus* has it been so far proved that it ascends somewhat above the base of Middle Cambrian.

2. The Australian *Archaeocyathinae*, which all appear to lie on about the same geological horizon in regard to one another, appear to be of about the same age as those of Siberia and Sardinia, *viz.*, base of Middle Cambrian or top of Lower Cambrian. The trilobite and brachiopod fauna which immediately succeed, in conformable strata, confirm this view.

3. Up to the present the known Cambrian strata in South Australia above the *Archaeocyathinae* limestones are for the most part Middle Cambrian, and their fossils are comparable to those of the Albertan Series of British Columbia.

4. The correctness of Professor Howchin's views as to the Lower Cambrian age of the greater part, if not the whole, of the Adelaide Series is rendered very probable when account is taken of the general geological horizons of the *Archaeocyathinae* throughout the world.

5. More information is needed, particularly in the Italowie and Yudnamutana region and to the northern extremity of the Flinders Ranges, etc., before the exact sequence of the rocks below the *Archaeocyathinae* limestones and above the undoubted Pre-Cambrian crystalline complex can be ascertained.

---

(16) Mawson, D., "Igneous Rocks of the Mount Painter Belt." Trans. Roy. Soc. S. Austr., vol. xlvii., 1923, p. 382.

(17) Ward, L. K. Trans. Roy. Soc. S. Austr., vol. xlix., 1925, p. 79.

(18) Mawson, D., "The Wooltana Basic Igneous Belt." *Ibid*, vol. l., 1926, pp. 195, 196.

(19) Madigan, C. T., "Geology of the Fleurieu Peninsula," etc. Trans. Roy. Soc. S. Austr., vol. xlix., 1925, pp. 204, 205.

(20) Thomas, R. Grenfell. Trans. Roy. Soc. S. Austr., vol. xlviii., 1924, pp. 258-268, pls. xxiii., xxiv., and Holmes, Arthur, "The Age of the Earth," 1927, p. 74, Benn's Sixpenny Library, No. 102.

MISCELLANEA.

ISLANDS IN BASS STRAIT UPON WHICH KANGAROO AND WALLABY ARE FOUND.

By Edwin Ashby, F.L.S., etc.

In October last, in company with Mr. A. J. Campbell, I visited the famous Mutton Bird Rookery at Cape Wallomai, with a view to negotiating the setting apart of that Cape as a Public Reserve. A Mr. John Burgess was staying with our host, Mr. J. B. Cleland, at the same time. Mr. Burgess is the skipper of a ketch engaged in the crayfish industry throughout the islands of Bass Strait, in fact he has spent most of his life amongst these islands. It was a unique opportunity to obtain particulars of the many bird rookeries scattered throughout that area; these details I am publishing in an Ornithological journal.

In addition to this information Mr. Burgess gave me a list of those islands upon which he has seen kangaroo and wallaby. I have in this note retained the vernacular name made use of by Capt. Burgess; but it may be presumed that the species referred to under the name "kangaroo" is some form of Bennett's wallaby *(Macropus bennetti)*, usually termed in Tasmania brush kangaroo, and that the term "wallaby" refers to some form of the rufous-bellied wallaby *(Macropus billardieri)*. I believe some of this information is new, and so furnish these particulars in the hope that workers who have the opportunity will investigate the forms existing on these various islets, for surely it is still possible that on one or other of these, a hitherto overlooked insular race may be found.

List of Islands.

In the Kent Group, kangaroo occur on *Deal Island*. *Flinders Island*, both kangaroo and wallaby. *Barren Island*, both kangaroo and wallaby. *Van Sittart Island*, kangaroo only. *Clark Island*, wallaby only. *Hummock Island*, wallaby only. *Babel Island*, both kangaroo and wallaby. *East and West Sisters*, wallaby only. In all Mr. Burgess has seen these marsupials on nine different islands.

Evening Meeting, July 14, 1927.

NOTE ON THE GEOLOGICAL AGE OF THE STURTIAN TILLITE OF SOUTH AUSTRALIA.

By J. W. Gregory, D.Sc., Professor of Geology in the University of Glasgow.
(Communicated by Professor Walter Howchin.)

"In regard to the Canadian Cobalt [Huronian or Newer Pre-Cambrian] glaciation, I think the whole tendency at present is against its recognition as glacial. I have twice searched the deposit for an ice-scratched stone, but found nothing but stones scratched by the matrix. Various American and Canadian geologists have done the same with the same result. I found mixed up with the loose weathered boulders some Pleistocene striated rocks. At the visit of the British Association two years ago all the men whose opinion counted stated that the relation of the deposit to the underlying rocks showed that it was not glacial; you may have seen Bain's last paper on "Is the Gowganda [Cobalt] Conglomerate Glacial?" in last year's 'American Geologist,' in which he has shown that the argument from the supposed level character of the country, at the time of this conglomerate is all wrong, and that the big boulders lie at the foot of a former highland. If the only argument for your glacials not being Cambrian is the correlation with those at Cobalt, they may as well stop at Cambrian."—[*Extract from letter dated University, Glasgow, May 19, 1927.*]

Evening Meeting, August 11, 1927.

ABSTRACT OF THE PROCEEDINGS

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA
(Incorporated)

FOR THE YEAR NOVEMBER 1, 1926, TO OCTOBER 31, 1927.

ORDINARY MEETING, NOVEMBER 11, 1926.

Mr. E. R. WAITE in the chair.

NOMINATIONS.—H. H. Finlayson, Assistant Lecturer, University of Adelaide, and A. R. Alderman were nominated as Fellows.

ELECTIONS.—P. D. Riddell, Director Technical High School, Broken Hill, N.S.W., and P. S. Stapleton were unanimously elected Fellows.

VISITOR.—Dr. Geissler, of the University of Halle, was welcomed as a visitor.

PAPERS—

R. S. ROGERS, M.A., "Contributions to the Orchidology of Australia."

R. H. PULLEINE, "The Aboriginal Occupation of the Tallywalka Lake System of New South Wales."

A. R. ALDERMAN (communicated by C. T. Madigan), "Petrographic Notes on Tonalite from the Palmer District, and Biotite-Norite from South Black Hill."

H. SHEARD: "Aboriginal Rock Carvings at Devon Downs, River Murray, South Australia."

N. B. TINDALE and H. SHEARD, "Aboriginal Rock Paintings, South Para River, South Australia."

C. S. HICKS, "Ancient Trade Weights."

EXHIBITS.—Mr. WAITE exhibited a paper with illustrations of *Varanus kommodensis*. Many exhibits were laid on the table by readers of the above papers.

ORDINARY MEETING, APRIL 14, 1927.

THE VICE-PRESIDENT (Dr. J. B. Cleland) in the chair. Forty members present.

CORRESPONDENCE.—A letter from Professor Wood Jones was read resigning his position as President of the Society. The TREASURER (Mr. Roach) moved—"That the Royal Society of South Australia, in accepting the resignation of Professor Wood Jones, F.R.S., as President of the Royal Society of South Australia, desires to express its regret that, because of his accepting a position at Honolulu, he has been unable to finish his term of office, and to express to him its profound thanks for the high services he has rendered science during his seven years' sojourn in South Australia." Carried unanimously.

ELECTIONS.—President, Professor T. G. B. Osborn; Representative Governor, Professor T. Harvey Johnston; Fellows, H. H. Finlayson, Assistant Lecturer,

Adelaide University, and A. R. Alderman, Adelaide University, were elected unanimously.

Papers—

Adelaide University Field Anthropology:

(1) T. D. Campbell and C. J. Hackett, "Introduction, Descriptive, and Anthropometric Observations."

(2) W. Ray, "Physiological Observations."

(3) J. B. Cleland, "Blood Grouping."

(4) E. H. Davies (communicated by W. Ray), "Aboriginal Songs and Music."

These papers were illustrated by specimens and by gramophone records taken and demonstrated by Dr. Davies.

J. B. Cleland, "Notes on a collection of Australian Myxomycetes identified by Miss Gulielma Lester."

J. B. Cleland and J. M. Black, "An enumeration of the Vascular Plants of Kangaroo Island." (The Orchids by R. S. Rogers.)

Exhibits.—Mr. Madigan exhibited the phragmacone of a Belemnite from Arkeringa Station, via Oodnadatta, presented by Master C. J. McLeod to the S.A. Museum, described by request. This is a remarkably well-preserved phragmacone in a block of Cretaceous limestone. Portions of Belemnite guards also are visible in the specimen, with molluscan remains. The only other recorded phragmacone from South Australia is in the Tate collection, Adelaide University, described and figured in the Memoirs of this Society, vol. 11, p. 17, by R. Etheridge, jun. Mr. Madigan said that in this specimen the phragmacone is twice the length of the guard, and he is perfectly satisfied that it is part of a Belemnite. Mr. A. M. Lea exhibited a collection of Australian sawflies (Tenthredinadae), including several new species named by Dr. Rirnar Foisins of Finland; also a large European longicorn beetle *(Lamia textor)*, recently taken alive in Adelaide from a piece of dead wood.

Ordinary Meeting, May 12, 1927.

The President (Professor T. G. B. Osborn) in the chair. Twenty members were present.

Elections.—Mr. E. R. Waite, C.M.Z.S., was elected a Vice-President (proposed by L. K. Ward, seconded by J. F. Bailey), by a unanimous vote. For Fellows—The following were elected unanimously:—E. H. Davies, Mus.Doc., University, Adelaide; E. W. Holden, B.Sc., Motor Manufacturer, Adelaide; C. J. Hackett, Medical Student, University, Adelaide; P. B. Paltridge, B.Sc., University, Adelaide; L. N. Birks, Motor Engineer, Adelaide; T. M. A. Boys, Photographer, Adelaide.

Nominations.—Harold Woodlands, F.R.H.S., Gardener, Adelaide, and Robert Frewer Kemp, Nurseryman, Cross Roads, Kingswood, were nominated as Fellows.

Exhibits.—Professor Howchin spoke on the phragmacone exhibited at last meeting by Mr. Madigan. The Professor exhibited a series of specimens indicating the range in size of the Belemnites, some from England, and one from Australia. He thought that there was a prospect of obtaining from the Australian Cretaceous rocks, guards larger than any previously recorded. Professor Howchin also showed a fragment of a glaciated floor from Lake Margaret in Tasmania, due to the Pleistocene glaciation. Sir Douglas Mawson showed a specimen of limestone outwardly resembling Halimeda limestone, obtained from the Flinders Range. The specimen had been examined by Mr. F. Chapman of the National

Museum, Melbourne, whose remarks would be conveyed in the form of a paper. The geological horizon was well above the tillite and overlying slates. It came from the Ammonia Mine, near Wooltana. Mr. C. T. MADIGAN showed excessively fine-grained galena and fibrous-radiating rhodochrosite. Miss MACKLIN showed five species of *Casuarina*, occurring in South Australia, which have all been previously called *Casuarina distyla*. The same difficulty and confusion had occurred in New South Wales. In Victoria the condition was the same. Some work done in South Australia has enabled five species here, and one in New South Wales, to be defined. Mr. A. M. LEA exhibited two species of giant Horntails *(Sirex)*, one got from Baltic spruce used in motor body building, the other a serious menace to *Pinus insignis* in New Zealand. The insects showed the danger of importation of species without their attendant parasites. Mr. Lea said it was most difficult to entirely prevent importation of insect pests. Professor J. B. CLELAND showed a sugary exudate on *Leptospermum pubescens* in South Australia. A similar exudation on eucalypts attracted honeyeaters in New South Wales. The exudation is possibly formed by an extraneous micro-organism. Mr. A. H. ELSTON showed the cotton boll weevil *(Anthonomus grandis)*, the specimens coming from Texas, U.S.A., and described the methods employed in combating the ravages of this menace. The PRESIDENT discussed the modern methods of attacking pests with dust sprays. Dr. T. D. CAMPBELL showed drawings dealing with the work of Mr. Alan Rowe, formerly of Adelaide, in Egyptology. Mr. Rowe is now field director of the Philadelphia University Museum. The section shows the results of some recent work in Palestine, where excavations had proved eight horizons dating back to 1400 B.C. Dr. Campbell also showed a photograph of aboriginal scars commonly seen on the left shoulder, and gave an account of the explanations given for this form of adornment.

ORDINARY MEETING, JUNE 9, 1927.

THE PRESIDENT (Professor T. G. B. Osborn) in the chair. Twenty-six members present.

ELECTIONS.—Mr. J. M. Black was elected a member of the Council; Harold Woodlands, F.R.H.S., and Robert Frewer Kemp were elected Fellows. The PRESIDENT referred to the valuable contributions of Mr. Black to the botany of South Australia. His great industry and singleness of purpose have given us a thoroughly reliable and modern Flora for our own State.

NOMINATION.—Bernard Dawson, M.D., F.R.C.S., as Fellow.

PAPERS—

Mr. FREDERICK CHAPMAN, A.L.S., "On a new Genus of Calcareous Algae." Sir DOUGLAS MAWSON said that more material is required to fix the geological horizon of the species which is at present in doubt.

Mr. A. M. LEA, "On the Genus *Emplesis* (Curculionidae)." These are the small weevils which are gregarious under bark, especially of eucalypts. Mr. Lea mentioned the loss to science of one of its great Australian supporters, the late H. L. White, of Belltrees, Scone, N.S.W., and moved that the Society send a note of condolence to the relatives. This was carried unanimously.

EXHIBITS.—Mr. E. ASHBY exhibited 44 species of humming birds, and gave an account of the Trochilidae. He discussed the possibility of introducing the Trochilidae into Australia. Dr. PULLEINE exhibited some tropical Nephilas, spiders notable for their gigantic orb webs, which were collected by the natives of the Northern Pacific and Indian Oceans for making baits for their fishing kites. Mr. KIMBER exhibited a number of fossil teeth of sharks, and fine specimens of *Spondylus arenicola*, all from Port Willunga. Dr. T. D. CAMPBELL exhibited a

denture made during the war, in which the teeth were made of hard white rubber; also some Testaments and school books in the Dieri language, which is now seldom spoken. Mr. E. R. Waite exhibited birds sent by Dr. Deland from Vanikoro. He stated that the feathers of one of them (a honeyeater) were those used in making the tavau. Mr. Waite also showed a roll of tavau. The paper Mr. Waite is publishing in the "Records of the S.A. Museum" will correct a long-standing error as to the origin of the red feathers used in making the tavau, which up till now were believed to have come from a species of *Trichoglossus*.

Ordinary Meeting, July 15, 1927.

The Vice-President (Professor J. B. Cleland) in the chair. Forty members present.

Professor J. A. Prescott and Sir Douglas Mawson were nominated delegates to the Hobart meeting of the A.A.A.S. next January.

Nominations.—Mr. H. C. Trumble, M.Ag.Sc., and Dr. S. W. Pennycuick were nominated as Fellows.

Election.—Dr. Bernard Dawson, M.D. (Lond.), F.R.C.S. (Eng.), was elected a Fellow.

Papers—

Mr. B. F. Goode, B.Sc., "The Mannum Granite and Associated Basic Dyke," communicated by Sir Douglas Mawson, who said that the outcrop was the best on the Murray for hundreds of miles, and approached to the form called adamellite, with dykes of lamprophyre.

Mr. H. L. Sheard, "Aboriginal Rock Carvings and Shelters—three localities on the Lower Murray."

Professor T. Harvey Johnston, "New Trematodes from an Australian Siluroid Fish." The freshwater cat-fish *Tandanus* of the Queensland rivers, he said, was infested by flukes similar to those found in other cat-fish in India and Japan, and that these parasites infested the swim-bladder of the fish.

Dr. J. B. Cleland and Mr Hackett, "Description of a New-born Aboriginal Infant." An aboriginal child was born at the Queen's Home, but did not survive birth. It was, at first, light in colour, but darkened very much within a few hours. It weighed 12 lbs., which is above the average weight and size. The hair was abundant and curly.

Exhibits.—Mr. A. M. Lea exhibited a collection of insects, including several new species from New Guinea, also rabbits' fur and bones from the Hawker Agricultural Bureau, which they considered to be probably ejected by one of the larger birds of prey. Dr. R. H. Pulleine exhibited a series of highly mineralized bones of some large marsupial (probably *Diprotodon)* from Hamilton Downs, Alice Springs, in the MacDonnell Ranges, where they were found by Mr. E. Harris, who reported that they were very abundant over an area of four acres, at the highest part of the ranges. Mr. E. Ashby exhibited a graft of a pear showing a large callosity, and referred to the sterility of the trees which were affected with callosities. This condition was a source of great trouble to orchardists in recent years. The only remedy was to destroy the tree. Mr. Waite exhibited a rainstone from the Diamantina River, presented to the Museum by Dr. Angas Johnson, and described its use and the accompanying ceremonials. He also exhibited a large aboriginal grinder found near Moorook, on the River Murray. Sir Douglas Mawson showed some photographs from the Kimberley district (South Africa) of polished rock pavements, laid bare by erosion, showing the marks of glacial action mixed with the petroglyphs of animals and other objects, carved by bushmen, and probably of great antiquity.

ORDINARY MEETING, AUGUST 11, 1927.

THE PRESIDENT (Professor T. G. B. Osborn) in the chair. Thirty members present.

NOMINATION.—F. K. Godfree, Merchant, Payneham, as Fellow.

ELECTIONS.—H. C. Trumble, M.Ag.Sc., Assistant Agronomist, Waite Institute, and Dr. Pennycuick, D.Sc., Lecturer on Physical Chemistry, Adelaide University, were elected Fellows.

VISITOR.—Mr. W. Condell was present as a visitor and exhibited precious opal, cut and uncut, from Stuart Range; precious stones from MacDonnell Ranges, Leigh's Creek and elsewhere, aerolites and part of a meteorite from Western Australia; also telluride from Western Australia.

MOTION.—Moved by Mr. W. H. SELWAY, seconded by Mr. E. ASHBY—"That this Society deplores the action taken by the Queensland Government in proclaiming an open season for the destruction of the koala, and respectfully suggests to the Prime Minister that the export of their skins be prohibited." Carried unanimously.

PAPERS—

A. M. LEA, F.E.S., "The Clawless and apparently Clawless Curculionidae of Australia." The paper dealt with Australian weevils, rendered remarkable by the absence, or apparent absence, of the claw joint from each foot.

Professor T. W. E. DAVID, "Note on the Geological Horizon of the Archaeocyathinae." This was illustrated by an elaborate diagram of the world-wide occurrences of Archaeocyathinae. Sir DOUGLAS MAWSON stated that the present paper discusses the occurrence of Archaeocyathinae and associated fossils in various regions of the world, with a view to determining as closely as possible its exact chronological position in the geological scale. Such determination has an important bearing on the age of the great series of Archaeocyathinae-bearing rocks in South Australia, already well described by Professor Howchin. The evidence collected indicates a Lower-Middle Cambrian as the age of Archaeocyathinae, and this is in accordance with Professor Howchin's expressed views.

Professor J. W. GREGORY (communicated by Professor Howchin), "Note on the Geological Age of the Sturtian Tillite of South Australia." Mr. MADIGAN stated that Professor Lawson, of California, had expressed to Dr. Ward his conviction that the Animikean conglomerates of Ontario were definitely tillites, thus opposing Gregory. Glacial indications are now being discovered in almost every geological period, and correlation is becoming very difficult.

J. C. JENNISON, "The Language of the Elcho Island Tribe, called by themselves Kokalango Mala." In some introductory notes he drew attention to the absence of sibilants and the sound of the letter "f." A silent breathing, similar to that in Tongan, was noted in many words. Malayan influence was proved by the occurrence of several words either exactly or closely similar to the Malay names for the same things, but these were all articles or activities foreign to the native tribes. The word for water was shown to be the same as that used by several Central Australian tribes. In discussing Mr. Jennison's paper, Mr. TINDALE said that in recording the native dialects of the western half of Arnhem Land, he had also met with Malay words among the coastal native tribes. Most of them were of the Buginese dialect of Celebes, but a few old Dutch words indicated that the latter people had also visited the coast. One of the native words for "gun" was "jinipa," which could be traced back to the old Dutch word for a "musket." All the introduced words related to trade, or to new objects and materials brought by the strangers. He also had traced the distribution of the word for water "papu" over Australia. It underwent a gradual metamorphosis as one

came south, but in its several forms was found from Sharks' Bay in Western Australia to the vicinity of Adelaide. Further east it was replaced by forms of two or three other words, such as "nukku." Dr. CAMPBELL said, in reference to Mr. Jennison's paper, that he would be interested to know if Mr. Jennison had recorded his vocabulary in accordance with the phonetic values internationally agreed upon. This was essential in order to make etymological records scientifically valuable.

P. C. MOUNTFORD, "On Certain Aboriginal Stone Structures in South Australia," and mentioned that these are the first to be recorded. Six examples were found, and the most perfect example, at the instance of Professor F. Wood Jones, was dismantled and presented to the South Australian Museum. He also mentioned that other examples had been photographed in the North Flinders Ranges.

EXHIBITS.—Messrs. H. L. SHEARD and P. C. MOUNTFORD exhibited the desiccated remains of an aboriginal child found near Swan Reach. A paper was read describing the circumstances of the discovery, and Mr. C. J. HACKETT dealt with the anatomical peculiarities of the exhibit and showed some interesting photographs. Dr. CAMPBELL said, in reference to the remains of the aboriginal child, that the teeth were of special interest, as, from the dentation, some reasonably close estimate could be made as to the age of the specimen. The deciduous molars were typical of the Australian native as to their size; they were extremely large teeth compared with those of modern white people. Mr. EDWIN ASHBY exhibited four bird skins of unusual interest. The largest was the skin of a White-breasted Sea Eagle *(Haliaetus leucegaster)* which had been picked up dead on Ackland's Hill, near Blackwood, on July 30 last. It was a young female, which, instead of having the beautiful white and grey plumage of the adult, was still in the dark plumage resembling that of the Wedge-tailed Eagle, except that the tail is white. The span of the wings was 7 feet 2 inches, and in its stomach were the remains of a rabbit. The second specimen was a female Osprey, or Fish Hawk *(Pandion haliaetus)*; this was shot in the valley of the Sturt, near Blackwood, on April 13, 1907, and had evidently been taking perch out of the River Sturt, for several of these fish were in its crop. The third specimen was that of the Square-tailed Kite *(Lophoictinia isura)*, also a female; in its stomach were the remains of egg-shell and fledgelings, probably of wattle birds or birds of about that size. We believe there is no other record of the occurrence of this bird within one, probably two, hundred miles of Adelaide; this was shot at Blackwood, on October 12, 1913. If it is strange that the two first-named birds of prey should be seeking their food so far away from their usual haunts, it is even more remarkable that the Square-tailed Kite should be found so far south of its usual habitat. The habit of searching in birds' nests for their young and their eggs is not unusual in this species, but surely it is a prostitution of its power of flight; its wings are, in proportion to its weight, seemingly well developed, and suited to both sustained and rapid flight. The fourth skin shown was that of the Royal Spoon-bill *(Platalea regia)*; the specimen was sent down from Scheutze's landing on the Murray on July 4 last, in a somewhat unsavoury condition. The long, black, spoon-like bill, black face and black legs set off the white plumage. While the Yellow-billed Spoonbill is fairly common on the Lower Murray, the Royal Spoonbill is quite rare in that part of the river.

ORDINARY MEETING, SEPTEMBER 8, 1927.

THE PRESIDENT (Professor T. G. B. Osborn) in the chair. Forty members present.

NOMINATION.—Herbert Henry Woollard, Elder Professor of Anatomy, University, Adelaide.

ELECTION.—F. K. Godfrey, Payneham, as a Fellow.

PAPERS—

CHARLES FENNER, D.Sc., "Adelaide, South Australia: A Study in Human Geography." The paper dealt chiefly with the physiographical features of the metropolitan region, under such characteristics as the Rift Valley, the Gulf Region, Adelaide Plains, Mount Lofty Ranges, the Torrens and its Estuary, the Tributaries of the Torrens and associated streams, and the Effects of Geographical Control on Human Conditions.

R. S. ROGERS, M.D., "Contributions to the Orchidology of Australia." The paper dealt principally with a new genus, *Goadbyella,* from Western Australia, which in its character lay midway between *Prosophyllum* and *Microtis.*

ELLEN D. MACKLIN, B.Sc., "A Revision of the '*Distyla* complex' of the Genus *Casuarina.*"

EXHIBITS.—Professor PRESCOTT exhibited test-tube specimens of earth in illustration of his paper. Mr. A. M. LEA, a section of a white ant's nest from the Mount Lofty Ranges, and worker and soldier ants; also, remarkable clawless weevils from Central Australia.

ANNUAL MEETING, OCTOBER 13, 1927.

THE PRESIDENT (Professor T. G. B. Osborn) in the chair. Forty-five members present.

Professor J. B. CLELAND read Obituary Notices of Professor Rennie and Dr. Ferguson, and Mr. B. S. ROACH read an Obituary Notice of Mr. Samuel Dixon. The former are published following the Annual Report, and the latter is incorporated in the Annual Report.

ELECTION.—Professor H. H. Woollard, M.D., Elder Professor of Anatomy, as a Fellow.

ELECTION OF OFFICERS.—*President,* Professor J. B. Cleland; *Vice-Presidents,* Mr. E. R. Waite and Dr. L. Keith Ward; *Hon. Treasurer,* Mr. B. S. Roach; *Members of Council,* Dr. C. Fenner and Professor J. A. Prescott.

NOMINATION.—Miss Violet Taylor, Business Manager, 40 Eton Street, Malvern, as a Fellow.

Sir JOSEPH VERCO made reference to the appointment of Professor T. G. B. Osborn to the Chair of Botany at the Sydney University, and referred to the valuable contributions to science and scientific work performed by Professor and Mrs. Osborn during their fourteen years' residence in South Australia.

PAPERS—

Professor W. HOWCHIN, "On the Sturtian Tillite in the Neighbourhood of Eden and in the Hundreds of Kapunda, Neales, and English." He said Eden and Viaduct Gully formed the northern limit of a great faulted block of tillite. It measured two miles in a north and south direction, and was one and three-quarter miles wide—the largest spread of these glacial beds known in South Australia. Another line of exposure occurred in the Hundred of Kapunda on the eastern slopes of the Allandale Range, between Tarlee and Kapunda. The glacial beds were strongly exposed on the public road between those two towns as well as on adjoining paddocks, on Ross' Creek, and Hawker's Creek. They curved round to the River Light, near Fords, on the Kapunda railway, in a line of outcrop seven miles in length. There was a third line of outcrop roughly parallel to the last-named, but 16 miles to the eastward forming the scarp hills that overlooked the Murray Plains, taking in the townships of Eudunda, Point

Pass, and Robertstown in a lineal direction through the Hundreds of Neales and English, and having a length of 19 miles.

C. T. Madigan, "The Geology of the Willunga Scarp." The author submitted a Map covering an area from Wickham's Hill, in the north-east, to the Carrickalinga Creek, in the south-west. He said that area provided evidence of the relationship which the members of the Adelaide Series bore to the Archaeocyathinae limestone of the Middle Cambrian age. In it were recognised the Mitcham quartzites, the Sturtian tillite, Tapley's Hill slates, Brighton limestone, and purple slates, in that order, from Wickham's Hill to Sellick's Hill along the scarp. All of them apparently rested on the Archaeocyathinae limestone. The apparent reversal of order was explained by the reversal of dip.

Professor F. Wood Jones (communicated by E. R. Waite). "The Mammals of Kangaroo Island." Mr. Waite said there were nine terrestrial mammals listed as occurring on the island. Four had been introduced by the Fauna and Flora Board—the ring-tailed opossum, the native bear, the rat kangaroo, and the wombat. The alien introduction of the pig and feral cat had been destructive to the native fauna and flora, but rabbits placed on the island many years ago had, fortunately, failed to establish themselves.

E. R. Waite, "The Reptiles and Amphibians of Kangaroo Island." The reptilian fauna included two marine turtles and fourteen lizards, of which the "iguana" was the only indigenous carnivorous animal on the island. The shingle-back (or sleepy lizard) had been introduced. The only snake found on the island was the tiger snake, but there it was so subject to melanism, or blackness, that the characteristic dark bands were almost lost in the general depth of colour. There were five species of amphibians, which were all common to the mainland.

H. M. Hale, "The Crustacea of Kangaroo Island." The paper dealt with ninety species of Crustacea taken on or near the shores of Kangaroo Island, including a new Isopod, an inhabitant of sea grasses.

Sir Douglas Mawson, "Geological Notes on an Area along the North-Eastern margin of the North-Eastern portion of the Willouran Range." Rocks in the neighbourhood of Mundowdna siding were of the nature of slates and breccias. Travelling west they gave way at Hogan's Well to quartzites and other rocks of a different nature. The latter formation was traversed by a basic igneous formation, and was intersected by many mineral veins carrying copper ores with traces of gold and vanadium. Sir Douglas Mawson also read a short paper on "The Paralana Hot Spring."

H. H. Finlayson, "Observations on the South Australian Members of the Sub-genus *Wallabia*, Part I." This paper treated, after a brief introduction, with the history of the species in literature, its past and present position in the fauna of the State, its distribution and habits, impressions gained from examination and photographing of a living example, and included a description of certain external and cranial characters previously either overlooked or incorrectly recorded.

J. B. Cleland, "Australian Fungi, Notes and Descriptions, No. 6."

Albert H. Elston, "Revision of the Australian Elateridae, Part II."

P. S. Stapleton, "Supposed Aboriginal arrangement of Pebbles at Pedler's Creek, South Australia."

J. M. Black, "Additions to the Flora of South Australia, No. 25."

The Annual Report and Financial Statements were read and adopted.

ANNUAL REPORT.

FOR YEAR ENDED SEPTEMBER 30, 1927.

The Society has continued to show great activity during the past year, 1926-1927. This is evinced by the good attendance of Fellows at the monthly meetings and by the number and variety of the papers presented. The number (34) is greater than that for any previous year in the history of the Society.

Papers of local Anthropological interest have been prominent, largely owing to the contributions of members of the Adelaide University Field Anthropological Expedition to Central Australia in January last. When we recall the difficulties that attended the collection of data published in some of the earlier volumes, it is a matter of interest to note the comparative ease with which this Expedition was conducted as well as the value of the results it achieved.

Geological papers, as usual, bulk large in our annual volume, including contributions from Professor Sir Douglas Mawson, Professor Howchin, Dr. C. Fenner, and Mr. Madigan. Professors Sir Edgeworth David and Gregory have also used our Transactions as a medium for the publication of results of special local interest.

Botanical papers have been contributed by Dr. Rogers, Mr. Black, and Miss Macklin.

On the Zoological side, Messrs. Lea and Elston have added largely to our knowledge of the Australian Coleoptera, and Mr. Hale has continued his untiring work on Crustacea.

The number and excellence of the exhibits have contributed largely to the interest of the meetings, and in this connection Messrs. Ashby and Lea have consistently helped.

The departure of our President, Professor F. Wood Jones, F.R.S., for Honolulu, caused general regret. He left with the sincere good wishes of all the Fellows for his success in his important new work. Professor T. G. B. Osborn, President, 1925-1926, was elected to the chair for the remainder of the session.

Professor Harvey Johnston was elected our Representative Governor on the Board of the Public Library, Museum and Art Gallery for the remainder of Professor Wood Jones' term, and has been re-appointed for the ensuing year.

The Council has met on eight occasions. The attendances are as follow:—President: (Prof. Osborn), 5. Vice-Presidents: Prof. Cleland, 6; Mr. Waite, 8. Sir Joseph Verco, 8; Prof. Howchin, 8; Drs. Fenner and Ward, 8; Mr. Lea, 7; Prof. Harvey Johnston, 6; Mr. Black, 4 (elected during the year); Hon. Treasurer and Hon. Secretary, 7.

The Library Committee reports that binding has progressed as far as the grant permits, but that the arrears are still heavy. The question of additional shelving is urgent.

The membership roll is as follows:—Hon. Members, 6; Fellows, 142. Total, 148.

It is a pleasure to record that the honour of Companion of the Most Distinguished Order of St. Michael and St. George was conferred by His Majesty on Professor W. Chapman in June last.

During the past year the Society has suffered loss by the deaths of three of its Fellows—Mr. Samuel Dixon, Professor Rennie, and Dr. Ferguson. Obituary Notices of Professor Rennie and Dr. Ferguson, contributed by Professor J. B. Cleland at the Council's request, appear below.

Mr. Samuel Dixon was elected a Fellow in 1887. He served on the Council from 1889 until 1918, when increasing age and its accompanying deafness caused him to resign. Mr. Dixon contributed 5 papers to these Transactions: Hydatid Disease in Sheep, vol. vi.; Notes on the Supposed Coal-beds of the Fitzgerald River, vol. vii.; Remarks on some Indigenous Shrubs, vol. viii; On a Subterranean Water Supply for the Broken Hill Mines, vol. xiv., and Effects of Settlement upon the Indigenous Vegetation, vol. v. Perhaps he will best be remembered for his great interest and vigorous support of all movements connected with afforestation and preservation of native fauna and flora. For 23 years he was chairman of the Native Fauna and Flora Protection Committee of the Field Naturalists' Section of this Society. Vol. xxxv. of these Transactions contains his valedictory address. In this he referred to his connection with the early phases of the National Park, Belair, important Nature reserve, as well as playground for the people, that was nearly lost to the State. Mr. Dixon was actively associated with the movements extending over a period of 27 years for the foundation of a Flora and Fauna Reserve on Kangaroo Island. Flinders Chase, founded 1919, owes much to his championship. He served on the Board of Governors of the Chase as a representative of this Society from the foundation of the Board in 1919 until 1921.

T. G. B. Osborn, *President.*

Robert Pulleine, *Secretary.*

October 13th, 1927.

OBITUARY NOTICES.

PROFESSOR E. H. RENNIE.

The Society has suffered a heavy loss in the sudden death on January 8th, 1927, of Edward Henry Rennie, M.A., D.Sc., Angas Professor of Chemistry in the University of Adelaide, whose personality, ability, and services have meant so much to the Society itself and to its officers and members during the many years of his residence in Adelaide. Almost immediately after his arrival in Adelaide, and before he had commenced his lectures in Chemistry, he was elected a Fellow of the Society on March 3rd, 1885, and at the time of his death had thus been associated with the Society for nearly 42 years. During this long period, he occupied a seat at the Council table from the end of 1885 till 1921, 36 years in all, being President from 1886 till 1889, and again from 1900 till 1903, and being a Vice-President from 1903 till 1919. Such a period of service, and the bestowal on him of such high and honourable offices, are in themselves clear indications of the value attached to his counsels and advice. Those who have had associations with him, in the Society as well as in the University, in scientific circles, and in friendship, know how well he deserved the trusts placed in him. His conscientiousness was proverbial, his scholarly attainments were high, his scientific ability was universally acknowledged, and his tact and sound judgment were of great value. Underneath a quiet exterior, with perhaps a suggestion of a somewhat gloomy outlook on things in general, there lay a keen appreciation of the lighter side of the amenities of life. He was a serious and enthusiastic fisherman and an excellent companion on a long country ramble, but it was in the intimacy rendered possible by vacations at the seaside, under the same roof, that one really felt that one knew him and could appreciate his sterling qualities and realise his services to the State.

Professor Rennie was born at Sydney on August 19th, 1852, the son of Edward Alexander Rennie, later Auditor-General of New South Wales, and a grandson of James Rennie, Professor of Zoology at King's College and author of "Insect Architecture." He took his B.A. degree in Sydney in 1870, and his M.A. in 1876. He was a master in the Sydney Grammar School from 1870 to 1875, and in the Brisbane Grammar School in 1876-7. He then proceeded to London and graduated D.Sc., Lond., in 1881. For two years he was assistant to Dr. C. R. Alder Wright in the Chemical Department of St. Mary's Hospital Medical School, and on his return to Australia was connected with the Government Analyst's Department in Sydney. In 1884 he was appointed to the Angas Chair in the young University of Adelaide, taking up duties in February, 1885. For some years he was also Government Analyst for South Australia. Through his hands, in Adelaide, have passed a long list of medical, dental and science students who have all appreciated the excellence of his lectures and the soundness of his teaching. As the number of his students increased, the inadequacy of the accommodation added greatly to the demands on the teaching staff, and though from time to time makeshift additions were made, the building of a special Chemical Block has long been urgent. The time when this will be accomplished now seems not far distant, but to our great regret the man by whom it would have been most appreciated, as the crowning point of his University labours, is no longer with us. Though the needs of his department were great, Dr. Rennie's fair-mindedness allowed him to appreciate when those of other departments were even greater. He thus strongly supported the measures that culminated in the fine new

block housing the Departments of Physics and Engineering. As an example of his conscientiousness as a teacher, it may be noted that when Chemistry entered some years back on a new phase of development and became more closely linked with Physics, Professor Rennie mastered the principles of the new outlook so as to be able to impart the necessary knowledge in his usual lucid manner—a task requiring no mean effort in a man no longer young.

On November 27, 1889, he was elected a member of the University Council, a position calling for still further inroads on his time and energies. He resigned from the Council in 1898, but was again a member from 1909 till the time of his death. Thereby the University gained much, though the Angas Professor found his time for research work still further reduced, time already gravely encroached on by the necessities of teaching. The experience gained at the University Council led to his being appointed Acting Vice-Chancellor during the absence of the Vice-Chancellor, Professor, now Sir William Mitchell, during 1924-5 and 1925-6. In August, 1926, he held the highest office open to a man of science in Australasia—that of President of the Australasian Association for the Advancement of Science.

On December 12, 1917, he delivered the Annual University Commemoration Address, entitled, "The Importance of Chemistry in Connection with the War." Dr. Rennie was a Fellow of the Chemical Societies of London and Berlin and of the Institute of Chemistry of Great Britain and Ireland, and a member of the Australian National Research Council. He was also Chairman of the State Committee of the Commonwealth Institute of Science and Industry, the fore-runner of the present Council for Scientific and Industrial Research, and consequently had a seat on the Executive Council of the former. He delivered three Presidential addresses to our Society, viz.: in 1888 (vol. xi., p. 225), on "The Present State of Industries in South Australia in which Chemical Science is Involved"; in 1901 (vol. xxv., p. 157), on "Agriculture in its Relation to Biology and Chemistry"; and in 1903 (vol. xxvii., p. 319), on "The Fisheries of Australia." He contributed the following papers:—"Analysis of Water from the Dry Creek Bore" (vol. iii., p. 179); "Poisoning by Tinned Foods" (vol. ix., p. 10); "Notes on the Colouring Matter of *Drosera Whittakeri*" (vol. x., p. 72); "On some so-called South Australian Garnets" (vol. xi., p. 17); "The Fluorescence of *Bursaria spinosa*" (vol. xiii., p. 237). With E. F. Turner: "Note on a Volcanic Ash from the Island of Tanna, New Hebrides" (vol. xiv., p. 256), and "On the Poisonous Constituents of *Stephania hernandifolia*" (vol. xvii., p. 186). With A. J. Higgin: "Notes on Supposed Volcanic Dust from the Northern Territory" (vol. xxvii., p. 205); and with W. T. Cooke: "Preliminary Analytical Notes on Certain New Minerals" (vol. xxx., p. 193).

DR. E. W. FERGUSON.

Dr. Eustace William Ferguson was born at Invercargill, N.Z., on October 24, 1884, and died in Sydney, after a long illness, on July 18, 1927. At the age of ten he came to Sydney with his parents, the Reverend John Ferguson and Mrs. Ferguson. He graduated M.B., Ch.M., Syd., with honours, in 1908, and recently added the Diploma of Public Health to these qualifications. In June, 1913, he was appointed Assistant Microbiologist to the Department of Public Health, N.S.W. From 1915 to 1918 he served as Captain with the Australian Army Medical Corps in France and Palestine, his knowledge of entomology, and especially of mosquitoes, being of great value in connection with the control of malaria in the latter field of operations. He succeeded, in 1920, to the position of Principal Microbiologist of the Health Department

when Dr. J. B. Cleland was appointed to the Chair of Pathology in Adelaide, and retained this position till his death. As well as a pathologist and bacteriologist of high repute, he was an entomologist of distinction, being an authority on the Amycterides (Coleoptera) and on the Diptera. He contributed many papers on entomology to the Linnaean Society of New South Wales, and to other societies, and applied his knowledge of this subject with great success to medical and veterinary problems.

On May 8, 1914, he was elected a Fellow of this Society, and contributed in that year Part I. of "Notes on the Amycterides in the South Australian Museum, with Descriptions of New Species" (vol. xxxviii., p. 11), and Part II. in the following year (vol. xxxix., p. 57). In 1922 he was elected President of the Royal Zoological Society of New South Wales, and in 1926 President of the Linnaean Society of New South Wales. His medical contributions, many of which had an entomological bearing, have appeared chiefly in "The Medical Journal of Australia," and in the Annual Reports of the Microbiological Laboratory, Department of Public Health, N.S.W. Quiet and unobtrusive in manner, thoroughly reliable and capable, it was a pleasure to work with him as a colleague and to feel that responsibilities were shared. In our Proceedings (vol. xxxi., p. 157), Mr. A. M. Lea described a new curculionid beetle as *Mandalotus fergusoni* after its discoverer, Dr. E. W. Ferguson. A tenebrionid beetle, named by Mr. H. J. Carter as *Otrintus fergusoni*, is a synonym of *Cardiothorax politicollis*, Bates. Dr. Ferguson's name is also perpetuated in the following:—Genus *Fergusonina*, Malloch (Diptera, Fam. Agromyzidae); the mosquito *Culicada fergusoni*, Taylor *(Aedes (Ochlerotatus) fergusoni*, Taylor); an anthomyid fly, *Phaonia fergusoni*, Malloch; a sand fly, *Simulium fergusoni*, Tonnoir; a tachinid fly, *Schizotachina fergusoni*, Bezzi; a muscid fly, *Viviparomusca (Musca) fergusoni*, Johnston and Bancroft; the fly *Sarcophaga fergusoni*, Johnston and Tiegs; and the March fly, *Silvius fergusoni*, Riccardo. His valuable collection of Amycterides (weevils) has been presented by his widow to the Macleay Museum, University of Sydney.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Receipts and Payments Account for the Year Ended September 30, 1927.

RECEIPTS.

	£ s. d.	£ s. d.
To Balance, October 1, 1926		618 15 5
,, Subscriptions	165 18 0	
,, Field Naturalists' Section	48 11 3	
		214 9 3
,, Grants from Government—		
On Subscriptions	143 5 4	
For Printing Reports and Scientific Investigations	150 0 0	
		293 5 4
,, Use of Room by other Societies		7 10 6
,, Sale of Publications		46 11 0
,, Interest—		
Savings Bank Account	21 1 2	
Transferred from Endowment Fund	183 7 7	
		204 8 9
		£1,385 0 3

PAYMENTS.

	£ s. d.	£ s. d.
By Transactions—		
Printing	312 9 9	
Illustrating	172 5 8	
Publishing	11 9 9	
		496 5 2
,, Grant—Field Naturalists' Section		50 0 0
,, Library—		
Librarian	56 4 6	
Bookbinding	13 19 6	
Miscellaneous	4 13 8	
		74 17 8
,, Sundries—		
Cleaning and Lighting	3 19 0	
Printing, Postage and Stationery	22 4 6	
Insurance	6 15 0	
Filing Rules at Supreme Court	0 7 6	
		33 6 0
,, Life Members' Accounts Transferred to Endowment Fund		80 0 0
,, Balance, September 30, 1926—		
Savings Bank of S.A.	554 7 2	
Bank of Australasia	96 4 3	
		650 11 5
		£1,385 0 3

ENDOWMENT FUND.

(Capital £4,069 6s. 10d.)

	£	s.	d.	£	s.	d.
1926—October 1						
To Balance, S.A. Government Stock	3,984	18	9			
Savings Bank	4	8	1			
				3,989	6	10
1927—September 30.						
,, Life Members				80	0	0
,, Interest received				183	7	7
				£4,252	14	5

		£	s.	d.	£	s.	d.
1927—September 30.							
By Revenue Account					183	7	7
,, £500 S.A. Govt. Stock	@ 3%	292	8	9			
,, £2,000 S.A. Govt. Stock	@ 3¾%	1,997	10	0			
,, £900 S.A. Govt. Stock	@ 5¼%	900	0	0			
,, £875 S.A. Govt. Stock	@ 5½%	875	0	0			
		4,064	18	9			
,, Savings Bank Account		4	8	1			
					4,069	6	10
					£4,252	14	5

Audited and found correct,

W. CHAMPION HACKETT, } Hon.
HOWARD WHITBREAD, } Auditors.

B. S. ROACH, Hon. Treasurer.

Adelaide, October 7, 1927.

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1927.

TRANSACTIONS, JOURNALS, REPORTS, ETC.,
presented by the respective governments, societies, and editors.

AUSTRALIA.

AUSTRALASIAN ANTARCTIC EXPEDITION, 1911-14. Sci. rep., s. C., v. 8, pt. 3.
AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Proc., 1924.
AUSTRALASIAN INSTITUTE OF MINING. Proc., no. 60-63. Melb., 1925-26.
AUSTRALIA. *Bureau of Census and Statistics.* Yearbook, no. 19, 1926.
——— *Council for Sci. and Industrial Research.* Bull. 30-32. Journ., v. 1, no. 1. Science abstracts, v. 5, no. 4; 6, no. 1-3. Melb. 1926-27.
——— *Dept. of Health.* Service publication, no. 32-33; tropical, no. 9.
——— *Fisheries.* S. "Endeavour" Zool. results, v. 5, pt. 4, 6-7. Melb.
——— *Meteorology.* Rain-map of Australia, 1926. Melb.
AUSTRALIAN JOURNAL OF EXPERIMENTAL BIOLOGY, v. 3, pt. 3-4; 4, pt. 1-2.
AUSTRALIAN VETERINARY ASSOCIATION. Journ., v. 2, no. 3-4; 3, no. 1. Syd.

SOUTH AUSTRALIA.

ADELAIDE UNIVERSITY. *Animal Products Research.* Rep., no. 6. Adel. 1926.
PUBLIC LIBRARY, MUSEUM AND ART GALLERY OF S.A. Rep., 1925-26. Adel.
——— Records of S.A. Museum, v. 3, no. 3. Adel. 1927.
SOUTH AUSTRALIA. *Botanic Garden.* Report, 1926-27. Adel.
——— *Dept. of Mines.* Review, no. 44-45. Adel. 1926-27.
——— *Geological Survey.* Bull., no. 12. Report, 1925. Adel.
——— *Woods and Forests Dept.* Report, 1925-26. Adel. 1926.
SOUTH AUSTRALIAN NATURALIST, v. 7, no. 4; 8, no. 1-3. Adel. 1926-27.
SOUTH AUSTRALIAN ORNITHOLOGIST, v. 8, pt. 8; 9, pt. 1-3. Adel. 1926-27.
SOUTH AUSTRALIAN SCHOOL OF MINES. Report, 1926. Adel. 1927.

NEW SOUTH WALES.

AUSTRALIAN MUSEUM. Museum magazine, v. 2, no. 12; 3, no. 1-3.
——— Records, v. 14, no. 5; 15, no. 2-5. Report, 1925-26. Syd.
LINNEAN SOCIETY OF N.S.W. Proc., v. 51, pt. 3-5; 52, pt. 1-2. Syd. 1926-27.
MAIDEN, J. H. Critical revision of the genus Eucalyptus, pt. 67-68. Syd.
NEW SOUTH WALES. *Dept. of Agric.* Gazette, v. 37; 38, pt. 1-9. Sci. bull. 28.
——— *Dept. of Mines.* Report, 1926. Syd. 1927.
——— *Public Library.* Report, 1926. Syd. 1927.
ROYAL SOCIETY OF N.S.W. Journ. and proc., v. 59, 1925. Syd. 1926.
ROYAL ZOOLOGICAL SOCIETY OF N.S.W. Australian zoologist, v. 4, pt. 5-6. Syd.

QUEENSLAND.

QUEENSLAND. *Dept. of Agriculture.* Journ., v. 26-27; 28, pt. 1-3. Brisb.
——— *Geological Survey.* Publications, no. 268, 277. Brisb. 1926.
QUEENSLAND MUSEUM. Mem., v. 9, pt. 1. Brisb. 1927.
ROYAL SOCIETY OF QUEENSLAND. Proc., v. 38. Brisb. 1927.

TASMANIA.

ROYAL SOCIETY OF TASMANIA. Proc., 1926. Hobart. 1927.
TASMANIA. *Dept. of Mines.* Underground water-supply paper, no. 4.
——— *Geological Survey.* Bull. no. 37. Hobart. 1926.

VICTORIA.

Royal Society of Victoria. Proc., v. 39, pt. 1. Melb. 1926.
Victoria. *Dept. of Agriculture.* Journ., v. 24, pt. 9-12; 25, pt. 1-8. Melb.
——— *Geological Survey.* Bull. no. 49. Melb. 1926.
——— *National Museum.* Mem. no. 7. Melb. 1927.
Victorian Naturalist, v. 43, no. 6-12; 44, no. 1-5. Melb. 1926-27.

WESTERN AUSTRALIA.

Royal Society of W.A. Journ., v. 12. Perth. 1925-26.
Western Australia. *Dept. of Agriculture.* Journ., v. 3, no. 3-4; 4, no. 1-2.
——— *Geological Survey.* Bull., no. 84, 86-87, 90-91, 93. Perth.

ENGLAND.

British Museum (Nat. Hist.). Economic ser., no. 2, 4a. Guide to meteorites. Lepidoptera phalaenas, new genera. Lond. 1926.
Cambridge Philosophical Society. Trans., v. 23, no. 10.
——— *Biological Science.* Proc., v. 3, no. 1-3. Camb. 1926-27.
Cambridge University. *Solar Physics Observatory.* Report, 1925-26.
Conchological Society. Journ., v. 18, no. 2-5. Lond. 1926-27.
Dove Marine Laboratory. Report, 1926. Cullercoats.
Entomological Society. Proc., v. 1; 2, pt. 1. Trans., v. 74; 75, pt. 1. Lond.
Geological Society of London. Journ., v. 82, pt. 3-4; 83, pt. 1-2. 1926-27.
Imperial Bureau of Entomology. Review, v. 14; 15, no. 1-7.
Imperial Institute. Bull., v. 24; 25, no. 1-2; and 21 pamphlets.
Linnean Society. Journ.: bot., no. 316-17; zool., no. 244-6. List, 1926-27.
——— Proc., 1925-26. Trans. zool., v. 19, pt. 1. Lond.
Liverpool Biological Society. Trans., v. 39-40. 1925-26.
Manchester Literary and Philosophical Society. Mem., v. 70, 1925-26.
National Physical Laboratory. Collected researches, v. 19. Rep., 1926.
Royal Botanic Gardens, Kew. Bull., 1926. Lond. 1927.
Royal Colonial Institute. United Empire, v. 17, no. 11-12; 18, no. 1-7. 1925-26.
Royal Geographical Society. Journ., v. 68-69; 70, no. 1-2. Lond. 1926-27.
Royal Microscopical Society Journ., 1926, pt. 3-4; 1927, pt. 1-2. Lond.
Royal Society. Proc. A., v. 112-114; B., v. 100-101. Yearbook, 1927. Lond.
Zoological Society of London. Proc., 1906-26. Trans., v. 22, pt. 1-2.

SCOTLAND.

Royal Physical Society of Edinburgh. Proc., v. 21, pt. 2. 1926.
Royal Society of Edinburgh. Proc., v. 37, pt. 4; 43, pt. 1; 46, pt. 3-4; 47, pt. 1. Trans., v. 54, pt. 3; 55, pt. 1. 1912-27.

IRELAND.

Royal Dublin Society. Proc.: economic, v. 2, no. 16; sci., v. 18, no. 17-28.
Royal Irish Academy. Proc., v. 37: A., pt. 6-9; B., pt. 10-21; C., pt. 7-12.

ARGENTINE.

Acad. Nacional de Ciencias. Bull. 28, no. 2; 29, no. 1-3. Cordoba. 1925-26.

AUSTRIA.

Akad. der Wissenschaften. *Math.-Nat. Klasse.* Jahr, 64. Mitt., no. 62-64. Sitz., Bd. 134, H. 3-10; 135, H. 1-6. Wien. 1925-26.
Geologische Bundesanstalt. Abh., Bd. 24, H. 1-2. Verh., 1926-27. Wien.

Naturhistorischen Hofmuseums. Ann., Bd. 40. Wien. 1926.
Zool.-Bot. Gesellschaft in Wien. Verh., Bd. 74-77. 1926-27.

BELGIUM.

Acad. Royale de Belgique. *Classe des Sciences.* Bull. 1926, no. 3-6. Mém. in 4°, t. 7; 8, f. 1-2. Mém. in 8°, t. 8, f. 10-12. Brux. 1926-27.
Instituts Solvay. Revue, 1925-26, t. 2, no. 2-3; 1927, no. 1-2.
Isis, ed. by Geo. Sarton, no. 9, 10, 13. Brux. 1921-23.
Société Royale des Sciences de Liège. Mém., t. 13. Brux. 1926.
Société Royale Zoologique. Ann., t. 56. Brux. 1925.
Louvain University. Lab. d'Astronomie. Publications, v. 1-2.

BRAZIL.

Instituto Oswaldo Cruz. Mem., t. 18, f. 1; 19, f. 1-2. Rio de Jan.
Museu Paulista. Revista, t. 14. S. Paulo.

CANADA.

Canada. *Geological Survey.* Economic geol., no. 2-3. Mem. 113, 148-150. Museum bull., no. 43, 45. Ottawa. 1926-27.
—— - *Mines.* Report, 1926; and six publications.
Royal Canadian Institute. Trans. v. 15, pt. 2; 16, pt. 1. Ottawa. 1926-27.
Royal Society of Canada. Proc. and trans., v. 20. Ottawa. 1926.

CEYLON.

Colombo Museum. Spolia Zeylanica, v. 14, pt. 1. 1927.

DENMARK.

Conseil Permanent Int. pour l' Explor. de la Mer. Bull.: hydro., 1925-26; stat., 1924. Pub. de circ., no. 88. Rapports, v. 37-43. Cpng.
Dansk Naturhistorisk Forening. Vid.-med., Bd. 81-82. Cpng. 1926.
Kobenhavn Universitets Zool. Museum. Publications, no. 44-48. 1926.
K. Dansk Videnskabernes Selskab. Biol.-med. 6, no. 1-3. Oversigt, 1926. Math.-fys. med. 7. Nat. og Math., t. 11, no. 1-2. Cpng. 1925-27.

FINLAND.

Societas Entomologica Helsingforsiensis. Not. entom., v. 2-4; 6.

FRANCE.

Muséum National d'Hist. Nat. Bull. 1925, no. 5-6; 1926, no. 1-5. Par.
Société des Sciences Nat. de l' Quest de la France. Bull., t. 5. Nantes.
Société Entomologique de France. Ann., v. 88-90; 95; 96, pt. 1-2.
——— Bull., 1926; 1927, no. 1-10. Par.
Société Linnéenne de Normandie. Bull., v. 8. Caen. 1926.
Société Linnéenne de Bordeaux. Actes, t. 77. 1925.

GERMANY.

Bayer. Akad. der Wissenschaften. Abh., Bd. 31, no. 1-3. Sitz., 1926.
Berliner Gesellschaft für Anthropologie. Zeits., 1926, H. 1-6.
Botanischen Gartens u. Museums. Notizb., no. 89-91. Berl. 1926-27.
Deutsche Entom. Gesellschaft. Zeits., 1926; 1927, H. 1-2. Berl.
Deutsche Entom. Museum. Mitt., Bd. 15; 16, no. 1-4. Berl. 1926-27.
Fedde, F. Repertorium, etc., Bd. 20-23; 24, no. 1-3. Berl. 1924-27.

Gesellschaft der Wissenschaften, Göttingen. Gesch. Mitt., 1925-26.
——— *Math-phys. Klasse.* Nach., 1926, H. 1-3. Göttingen.
Gesellschaft für Erdkunde. Erganz. H. Zeits., 1926; 1927. Berl.
K. Deutsche Akad. der Naturf. zu Halle. Leopoldina, Bd. 2.
Nassauischen Verein für Naturkunde. Jahrb., no. 78. Wiesb. 1926.
Naturforschende Gesellschaft zu Freiburg. Berichte, Bd. 26; 27, H. 1-2.
Naturhist. Gesellschaft zu Nürnberg. Abh., Bd. 21. Jahr., 1925-26.
Naturhistorische Museum, Hamburg. Mitt., Bd. 42. 1926.
Oberhessische Gesellschaft für Natur.-u. Heilk. Med. Abt., Bd. 9-13. Nat. Abt., Bd. 6-8. Giessen. 1915-22.
Preussische Akad. der Wissenschaften. Sitz., 1926; 1927, pp. 1-58. Phil. Hist., 1926; 1927, no. 1-11. Phys.-Math., 1926; 1927, no. 1-11. Berl.
Senckenbergische Naturf. Gesellschaft. Berichte, Bd. 56, H. 7-11.
——— Senckenbergiana, Bd. 8, H. 3-4. Frankfürt a M. 1926.

HAWAIIAN ISLANDS.

Bernice Pauahi Bishop Museum. Bull., no. 24-33. Honolulu. 1925-26.

HUNGARY.

Musée National Hongrois. Ann., v. 21, 23-24. Budapest. 1924-26.

INDIA.

India. Catalogue of Indian insects, pt. 11. Calc. 1926.
——— *Geological Survey.* Palaeontologica Indica, v. 7, no. 3; 8, no. 4; 9, no. 2; 10, no. 1-2; 14. Records, v. 59; 60, pt. 1. Calc. 1926-27.
——— *Zoological Survey.* Annual report, 1923-26. Calc.
Indian Museum. Records, v. 27, pt. 5-6; 28, pt. 1-4. Calc.
Panjab University. *Dept. of Zoology.* Mem., v. 1, pp. 1-18 Lahore.
Royal Asiatic Society, Bombay Br. Journ., v. 2, no. 2. 1926.

ITALY.

Laboratorio di Zoologia Generale e Agraria. Bull. 19. Portici. 1926.
Società di Scienze Naturali ed Economiche. Bull., v. 4-8, 1922 26.
——— Giornale, v. 34, 1924-26. Palermo.
Società Entomologica Italiana. Anno. 58; 59, no. 2-6. Mem., v. 5, f. 1.
Società Italiana di Scienze Naturali. Atti, v. 65, f. 2-4. Milan.
Società Toscana di Scienze Naturali. Mem., v. 35-37. Proc., v. 32-35. Pisa.

JAPAN.

Imperial Academy, Tokyo. Proc., v. 2, no. 6-10; 3, no. 1-6. 1926-27.
Imperial University of Tokyo. Journ., S. 1, v. 1, pt. 5; S. 2, v. 1, pt. 8, 2, pt. 1.
Kyôto Imperial University. *College of Engineering.* Mem. 4, no. 3-5.
——— *College of Science.* Mem., various, 1926-27. Kyôto.
National Research Council. Jap. journ.: astron., v. 4; bot., v. 3, no. 3; engin. abstr., v. 4-5; geol., v. 4, no. 1-2; math., v. 3; 4, no. 1; phys., v. 4, no. 2.
Tôhoku Imperial University. Sci. rep., I, v. 15; 16, no. 1-5; II, v. 9; 10, no. 2-3; III, v. 3, no. 1. Tech. report, v. 6, no. 2-4. Sendai. 1926-27.
Tôhoku Mathematical Journal, v. 27, no. 3-4; 28, no. 1-2. Sendai. 1926-27.
Tokyo University. *College of Science.* Journ., v. 44-45. 1922-25.

JAVA.

Natuur. Vereeniging in Ned.-Ind. Tijds, Deel 86, no. 2-3. Welt.

MALAYA.

Royal Asiatic Society (Br.) Journ., v. 4, pt. 2. Singap. 1926.

MEXICO.

Instituto Geologico de Mexico. An., t. 2, no. 1-4. Bull. 43, 45.
Mexico. *Dept. de Salubridad.* Bull. 1926, no. 3; 1927, no. 1-2.
Sociedad Científica "Antonio Alzate." Mem., v. 45-46. Mex. 1926.

NEW ZEALAND.

Canterbury Museum. Records, v. 3, no. 1. Christchurch. 1926.
Dominion Laboratory. Annual report, 58, 59. Well. 1926.
Dominion Museum. Bull., no. 6, 8. Well.
New Zealand. *Board of Science and Art.* Journ., v. 8; 9, no. 1-2. Well.
——— *Dept. of Mines.* Palaeontological bull., no. 11-12. Well. 1926-27.
——— *Geological Survey.* Bull., no. 29. Well. 1927.
New Zealand Institute. Trans., v. 57; 58, pt. 1-2. Well. 1927.

NORWAY.

Bergens Museum. Aarsb., 1926, pt. 1, 3. Bergen. 1925-27.
K. Norske Videnskabers Selskab. Aarsb., 1925. Skr., 1925-26. Trond.
Norske Vid.-Akad. i Oslo. *Mat.-Nat. Kl.* Skr., 1924, no. 3; 1925, no. 8-11.
Stavanger Museum. Aarshefte, 1924-25. Stavanger. 1927.

PERU.

Cuerpo de Ingenieros de Minas. Boletin, no. 108. Lima. 1926.

PHILIPPINE ISLANDS.

Bureau of Science. Journ., v. 31-33. Report, 24. Manila. 1926-27.

POLAND.

Société Botanique de Pologne. Actes, v. 2, no. 3-4. Warsaw. 1924-25.

RUSSIA.

Académie des Sciences de Russie. Bull., t. 19-20; 21, no. 1-2. Comptes rendus, 1926-27. Pacific Russian scientific investigations. 1926.
Société Russe de Minéralogie. Mem., v. 51-54. Moscow. 1918-25.
——— Matériaux pour la géologie de Russie, v. 26, pt. 1. 1918.

SPAIN.

Instituto General y Técnico de Valencia. *Nat. Hist.* An., v. 14.
Real Acad. de Ciencias y Artes. Mem., v. 15-17; 19; 20, no. 1. Barcelona.

SWEDEN.

Entomologiska Föreningen y Stockholm. Tidsk., Arg. 47. 1926.
Geologiska Föreningen. Forh., Bd. 48; 49, H. 1-2. Stockholm.

SWITZERLAND.

Geog.-Ethnog. Gesellschaft in Zürich. Mitt., 1924-26.
Institut National Genevois. Bull., t. 47. Geneva.
Naturforschende Gesellschaft in Zürich. Viert., 1926, H. 1-4.
Soc. de Physique et d' Hist. Nat. Compte rendu, v. 43, no. 3; 44, no. 1.
Soc. Neuchâteloise des Sciences Naturelles. Bull., t. 50, 1925.
Soc. Vaudoise des Sciences Nat. Bull. 218. Mem. 10, 14. Lausanne.

UNION OF SOUTH AFRICA.

Durban Corporation Museum. Report, 1926.
Geological Society of South Africa. Trans., 1926. Johannesb. 1927.
Royal Society of S.A. Trans., v. 13, pt. 4; 14, pt. 1-3; 15. Cape Town.
S.A. Assoc. for Advancement of Science. Journ., v. 23. Cape Town.
S.A. Museum. Ann., v. 20, pt. 6; 23, pt. 3; 25, pt. 1; 3 guides; rep., 1926.

UNITED STATES.

Academy of Natural Sciences. Proc., v. 78. Yearbook, 1925. Philad.
American Academy of Arts and Sciences. Proc., v. 61; 62, no. 1-2. Bost.
American Chemical Society. Journ., v. 48; 49, no. 1-8. Easton, Pa.
American Geographical Society. Review, v. 16; 17, no. 1-3. Index, 1916-25.
American Microscopical Society. Trans., v. 44-45; 46, no. 1-3. 1926-27.
American Museum of Natural History. Anthrop., v. 28, pt. 1. Bull. 52, 55. Guide, 38, 53, 61-65. Handb. 12. Mem. 13, pt. 3. "Natural History," v. 26; 27, no. 1-2. Novitates, no. 212-241. Report, 1925.
American Philosophical Society. Proc., v. 65, 1926. Philad.
Arnold Arboretum. Journ., v. 6-7; 8, no. 1-2. Camb., Mass.
Boston Society of Natural History. Occas. papers, v. 5, pp. 197-234. Proc., v., 37; 38, no. 1-7. Bost. 1923-25.
Brooklyn Institute. Museum qrly., v. 13, no. 3-4; 14, no. 1. 1926-27.
California Academy of Sciences. Occas., no. 12. Proc., v. 2, no. 18; 10, 11-12; 14, no. 18-20; 15, no. 1-16; 16, no. 2. San Fran.
California. *Mines.* Bull. 97. Oilfields, v. 11; 12, no. 1-8. Report, v. 22.
California University. Publications: arch., v. 18, no. 3; 19, no. 2-3; 21, no. 7; 23, no. 1; bot., v. 12, no. 4-8; 13, no. 7-10; entom., v. 4, no. 1-4; geol., v. 16, no. 3-4; zool., v. 21, no. 18; 24, no. 4; 28, no. 21-23; 29, no. 1-8; 30, no. 1-5.
Carnegie Institution of Washington. Hydrostatic system of trees, 1926. Samoan foraminifera, 1924. Yearb., 1926.
Conn. Acad. of Arts and Sciences. Trans., v. 28, pp. 79-293. New Haven.
Conn. Geological and Nat. Hist. Survey. Bull. 33-37. Hartford.
Cornell University. *Agr. Exp. Station.* 11 bull. 5 mem. Ithaca, N.Y.
Denison University. *Sci. Lab.* Journ., v. 21, 5-7; 22, 1-4. Granv., O.
Field Museum. Publications: bot. v. 6. no. 1; guide, pt. 6; report, v. 6, no. 5; zool., v. 12, pt. 12-13; 13, pt. 4; 16, pt. 1-2. Chic.
Franklin Institute. Journ., v. 202-3; 204, no. 1-2. Yearb., 1927. Philad.
Harvard College Museum. Bull., v. 67, no. 12-15; 68, no. 2-3. Rep., 1926.
Illinois. *State Lab. Nat. Hist.* Bull., v. 15, art. 8-9; 16, art. 1-3. Urbana.
Illinois University. Biological Monog., v. 10, no. 2 3. Urbana. 1926.
Indiana Academy of Science. Proc., v. 35, 1925. Indianapolis. 1926.
Johns Hopkins University. Studies, v. 43-44; 45, no. 1. Balt. 1925-27.
Kansas University. Bull.: humanistic studies, v. 4, no. 1. Lawr. 1926.
Marine Biological Lab., Wood's Hole, Mass. Bull., v. 51-52; 53, no. 1.
Minnesota. *Geol. and Nat. Hist. Survey.* Bull., no. 19-21. Minneap.
Minnesota University. Studies: biol., no. 5; lang., no. 9; social, no. 17.
Missouri Botanic Garden. Ann., v. 13. St. Louis. 1926.
National Academy of Sciences. Proc., v. 13, no. 2-8. Rep., 1921-26. Wash.
National Geographic Magazine, v. 50-51; 52, no. 1-2. Wash. 1926-27.
New York Public Library. Bull., v. 30; 31, no. 1-7. N.Y. 1926-27.
New York State Museum. Bull., no. 268-273. Albany. 1926-27.
New York Zoological Society. "Zoologica." v. 4, no. 5; 7, no. 2-3; 8, no. 1-3.
N. Carolina. *Geol. Surv.* "Natural Resources," v. 4. Rep., 1925-26.

OBERLIN COLLEGE. Laboratory bull., no. 49. 1926.
OHIO UNIVERSITY. Bull., v. 31, no. 5. Journ. of sci., v. 26; 27, no. 1-4.
SAN DIEGO SOCIETY OF NAT. HIST. Ann. rep., 1923-26. California mammals, by F. Stephens. Trans., v. 1-4; 5, no. 1-6. 1905-27.
SMITHSONIAN INSTITUTION. Annual report, 1925. Wash. 1926.
STANFORD UNIVERSITY. University ser.: biological sciences, v. 4, no. 1-3.
TENNESSEE. *Geological Survey.* Bull., no. 36. Nashville. 1925.
UNITED STATES. *Coast and Geodetic Survey.* Ser. no., 110, 118, 271. Wash.
——— *Dept. of Agric.* Bull. 1423, 1521. Exp. st. rec., v. 54-55; 56, no. 1-2, 7-8. Jour., v. 33-34. N.A. fauna, no. 48. Yearb., 1925. Wash.
——— *Geological Survey.* Mineral res., 1923-24. Rep. 47. Various bulls., etc.
——— *Library of Congress.* Report, 1926. Wash.
——— *National Museum.* Proc., v. 66. Rep. 1925-26, and 6 bull.
WAGNER INSTITUTE OF SCIENCE. Announcement, 1926-27. Bull. 1-5. Phil.
WASHINGTON UNIVERSITY, ST. LOUIS. Studies, v. 13, no. 2. 1926.

URUGUAY.

MUSEO NACIONAL DE MONTEVIDEO. Anales, ser. 2, t. 2, entr. 1-2.

LIST OF FELLOWS.

AS EXISTED ON SEPTEMBER 30, 1927.

Those marked with an asterisk (*) have contributed papers published in the Society's Transactions. Those marked with a dagger (†) are Life Members.

Any change in address or any other changes should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrear.

Date of Election.

Honorary Fellows.

1910. *Bragg, Sir W. H., K.B.E., M.A., D.Sc., F.R.S., Director of the Royal Institution, Albemarle Street, London (Fellow 1886).
1926. *Chapman, F., A.L.S., National Museum, Melbourne.
1897. *David, Sir T. W. Edgeworth, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S., F.G.S., Emeritus Professor of Geology, University of Sydney, Coringah, Sherbroke Road, Hornsby, N.S.W.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Thornhanger, Marlborough, Wilts, England.
1926. Spencer, Prof. Sir W. Baldwin, K.C.M.G., Litt.D., M.A., D.Sc., F.R.S., Emeritus Professor of Biology in the University of Melbourne, Director of the National Museum, Melbourne.
1894. *Wilson, J. T., M.D., Ch.M., Professor of Anatomy, Cambridge University, England

Fellows.

1926. Abel, L. M., Victor Harbour.
1925. Adey, W. J., Military Road, Grange.
1927. *Alderman, A. R., B.Sc., West Terrace, Kensington Gardens, S.A.
1895. *†Ashby, Edwin, F.L.S., M.B.O.U., Blackwood, S.A.
1917. Bailey, J. F., Director Botanic Garden, Adelaide.
1902. *Baker, W. H., King's Park, S.A.
1926. Beck, B. B., 127 Fullarton Road, Myrtle Bank, S.A.
1902. *Black, J. M., 82 Brougham Place, North Adelaide.
1912. *Broughton, A. C., The "Grosvenor," North Terrace, Adelaide.
1911. Brown, Edgar J., M.B., D.P.H., 172 North Terrace.
1883. *Brown, H. Y. L., 286 Ward Street, North Adelaide.
1924. Browne, J. W., B.Ch., 169 North Terrace, Adelaide.
1916. *Bull, Lionel B., D.V.Sc., Laboratory, Adelaide Hospital.
1923. Burdon, Roy S., B.Sc., University of Adelaide.
1921. Burton, R. J., Belair.
1922. *Campbell, T. D., D.D.Sc., Dental Dept., Adelaide Hospital, Frome Road.
1925. Carr, W. B., Partridge Street, Glenelg.
1924. Cavenagh-Mainwaring, W. R., M.B., B.S., 207 North Terrace.
1907. *Chapman, R. W., C.M.G., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University of Adelaide.
1904. Christie, W., c/o Griffiths Bros., Hindmarsh Square, Adelaide.
1895. *Cleland, John B., M.D., Professor of Pathology, University of Adelaide.
1907. *Cooke, W. T., D.Sc., Lecturer, University of Adelaide.
1924. de Crespigny, C. T. C., D.S.O., M.D., 172 North Terrace, Adelaide.
1916. Darling, H. G., Franklin Street, Adelaide.
1927. *Davies, Prof. E. Harold, Mus.Doc., The University, Adelaide.
1927. Dawson, Bernard, M.D., F.R.C.S., 8 King William Street, Adelaide.
1915. *Dodd, Alan P., Prickly Pear Laboratory, Sherwood, Brisbane.
1921. Dutton, G. H., B.Sc., F.G.S., Agricultural High School, Murray Bridge.
1911. Dutton, H. H., B.A., Anlaby, S.A.
1902. *Edquist, A. G., 19 Farrell Street, Glenelg.
1918. *Elston, A. H., F.E.S., "Hatherley," Commercial Road, Unley Park.
1925. England, H. A., B.Sc., 21 Davenport Terrace, Wayville West.
1917. *Fenner, Chas. A. E., D.Sc., 42 Alexandra Avenue, Rose Park.
1927. *Finlayson, H. H., The University of Adelaide.
1923. Fry, H. K., D.S.O., M.B., B.S., B.Sc., Glen Osmond Road, Parkside.
1919 †Glastonbury, O. A., Adelaide Cement Co., Brookman Buildings, Grenfell Street.
1923. Glover, C. J. R., Stanley Street, North Adelaide.
1927. Godfrey, F. K., Robert Street, Payneham, S.A.
1904. Gordon, David, 72 Third Avenue, St. Peters.

Date of Election.

1925. †Gosse, J. H., 31 Grenfell Street, Adelaide.
1880. *Goyder, George, A.M., B.Sc., F.C.S., 228 North Terrace.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University of Adelaide.
1922. Grant, R. L. T., M.B., B.S., M.R.C.P., Caius Chambers, 169 North Terrace, Adelaide.
1904. Griffith, H., Hove, Brighton.
1916. Hackett, W. Champion, 35 Dequetteville Terrace, Kent Town.
1927. *Hackett, C. J., 196 Prospect Road, Prospect, S.A.
1922. *Hale, H. M., S.A. Museum, Adelaide.
1922. *Ham, William, F.R.E.S., University of Adelaide.
1916. †Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., M.Am.I.M.E., Bundarra Road, Bellevue Hill, Sydney.
1924. Hawker, Captain C. A. S., M.A., North Bungaree, via Yacka, South Australia.
1896. Hawker, E. W., M.A., LL.B., F.C.S., East Bungaree, Clare.
1923. Hill, Florence M., B.S., M.D., University of Adelaide.
1926. Holdaway, F. G., M.Sc., The University of Minnesota, U.S.A.
1927. Holden, E. W., B.Sc., Dequetteville Terrace, Kent Town, S.A.
1925. Homburg, Hon. H., Grenfell Street, Adelaide.
1924. *Hossfeld, Paul S., M.Sc., Carey Street, Magill.
1883. *Howchin, Professor Walter, F.G.S., "Stonycroft," Goodwood East, S.A.
1918. *Ising, Ernest H., c/o Superintendent's Office, S.A. Railways, Adelaide.
1912. *Jack, R. L., B.E., F.G.S., Assistant Government Geologist, Adelaide.
1893. James, Thomas, M.R.C.S., 9 Watson Avenue, Rose Park.
1918. *Jennison, Rev. J. C., Mallala, S.A.
1910. *Johnson, E. A., M.D., M.R.C.S., Town Hall, Adelaide.
1910. *Johnston, Professor T. Harvey, M.A., D.Sc., University of Adelaide.
1920. *Jones, F. Wood, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., F.R.S., Honolulu.
1923. Judell, Lester M. W., B.Sc., Jamestown.
1926. Julius, Edwd., Conservator of Forests, Adelaide.
1918. Kimber, W. J., 28 Second Avenue, Joslin.
1915. *Laurie, D. F., Agricultural Department, Victoria Square.
1897. *Lea, A. M., F.E.S., South Australian Museum, Adelaide.
1884. Lendon, A. A., M.D., M.R.C.S., 66 Brougham Place, North Adelaide.
1922. Lendon, Guy A., M.B., B.S., M.R.C.P., North Terrace.
1925. Lewis, A., M.B., B.S., Adelaide Hospital.
1927. *Macklin, E. D., Miss, M.Sc., The University, Adelaide.
1922. *Madigan, C. T., M.A., B.Sc., University of Adelaide.
1923. Magarey, W. A., LL.B., Pirie Street.
1923. Marshall, J. C., Payneham.
1914. Mathews, G. M., F.R.S.E., F.L.S., F.Z.S., Foulis Court, Fair Oak, Hants, England.
1905. *Mawson, Sir Douglas, D.Sc., B.E., F.R.S., Professor of Geology, University, Adelaide.
1919. Mayo, Helen M., M.D., 47 Melbourne Street, North Adelaide.
1920. Mayo, Herbert, LL.B., Brookman Buildings, Grenfell Street.
1926. McCoy, H. A., M.B., Ch.M., 163 North Terrace, Adelaide.
1920. McGilp, John Neil, Napier Terrace, King's Park.
1907. Melrose, Robert T., Mount Pleasant.
1924. Messent, P. S., M.S., 192 North Terrace.
1925. †Mitchell, Professor W., M.A., D.Sc., The University, Adelaide.
1897. *Morgan, A. M., M.B., Ch.B., 46 North Terrace.
1924. Morison, A. J., Deputy Town Clerk, Town Hall, Adelaide.
1926. Moore, A. P. R., D.D.Sc., 193 North Terrace, Adelaide.
1926. *Mountford, C. P., 52 West Street, Torrensville.
1921. Moulden, Owen M., M.B., B.S., Unley Road, Unley.
1927. †Murray, Hon. Sir George, K.C.M.G., B.A., LL.M., Magill, S.A.
1925. North, Rev. Wm. O., Methodist Manse, Netherby.
1913. *Osborn, T. G. B., D.Sc., Professor of Botany, University of Sydney.
1927. Paltridge, T. B., B.Sc., The University of Adelaide.
1924. Pearce, C., 33 Capper Street, Kent Town.
1924. Perkins, A. J., Director of Agriculture, Victoria Square.
1926. Piper, C. S., B.Sc., Waite Agric. Research Institute, Glen Osmond.
1925. *Prescott, Professor J. A., M.Sc., A.I.C., Waite Agric. Research Institute, Glen Osmond.
1926. Price, A. Grenfell, M.A., F.R.G.S., St. Mark's College, North Adelaide.
1927. Prockter, H. A., 20 Pier Street, Glenelg.
1907. †*Pulleine, R. H., M.B., Ch.M., North Terrace, Adelaide.
1916. *Ray, William, M.B., B.Sc., Liberal Club Building, North Terrace, Adelaide.
1925. Richardson, Professor A. E. V., M.A., D.Sc., "Urrbrae," Glen Osmond.
1926. Riddell, P. D., Technical College, Broken Hill.
1911. Roach, B. S., Education Department, Flinders Street, Adelaide.

Date of Election.

1919. *ROBERTSON, Professor T. B., D.Sc., D.Ph., University of Adelaide.
1924. ROEGER, Miss M. T. P., c/o Central School, Goodwood.
1925. ROGERS, L. S., B.D.Sc., Verco Buildings, North Terrace.
1905. *ROGERS, R. S., M.A., M.D., 52 Hutt Street.
1922. *SAMUEL, GEOFFREY, M.Sc., University of Adelaide
1924. SANDFORD, J. WALLACE, 75 Grenfell Street.
1924. SEGNIT, R. W., M.A., B.Sc., Architect-in-Chief's Office, Victoria Square, Adelaide.
1891. SELWAY, W. H., Treasury, Adelaide.
1926. *SHEARD, HAROLD, Gawler.
1920. SIMPSON, A. A., C.M.G., C.B.E., Lockwood Road, Burnside.
1924. SIMPSON, FRED. N., Dequetteville Terrace, Kent Town.
1925. SMITH, ELMER, Ph.D., Sc.D., 1281 Paterson Plank Road, Secaucus, N.J., U.S.A.
1925. †SMITH, T. E. BARR, B.A., 25 Currie Street, Adelaide.
1906. SNOW, FRANCIS H., National Mutual Buildings, King William Street.
1923. SPROD, M. W., M.B., B.S., Moseley Street, Glenelg.
1927. STAPLETON, P. S., Henley Beach, South Australia.
1923. STRONG, Professor Sir ARCHIBALD, M.A., D.Litt., University of Adelaide
1922. SUTTON, J., Fullarton Road, Netherby.
1925. SYMONS, IVOR G., Church Street, Highgate.
1923. THOMAS, J. F., Tenterfield, N.S.W.
1923. *THOMAS, R. G., B.Sc., 5 Trinity Street, St. Peters, S.A.
1921. *TIEGS, OSCAR W., D.Sc., University of Melbourne.
1923. *TINDALE, N. B., South Australian Museum, Adelaide.
1894. *TURNER, A. JEFFERIS, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1925. TURNER, DUDLEY C., National Chambers, King William Street, Adelaide.
1878. *VERCO, SIR JOSEPH C., M.D., F.R.C.S., North Terrace, Adelaide.
1926. WAINWRIGHT, J. W., B.A., 32 Florence Street, Fullarton Estate.
1914. *WAITE, EDGAR R., F.L.S., C.M.Z.S., Director, South Australian Museum.
1924. WALKER, W. D., M.B., B.S., B.Sc., St. Mark's College, Pennington Terrace, N.A.
1912. *WARD, LEONARD KEITH, B.A., B.E., D.Sc., Government Geologist, Adelaide.
1920. WEIDENBACH, W. W., Rabaul, Papua.
1904. WHITBREAD, HOWARD, c/o A. M. Bickford & Sons, Currie Street.
1912. *WHITE, Capt. S. A., C.M.B.O.U., "Wetunga," Fulham.
1920. *WILTON, Professor J. R., D.Sc., University of Adelaide.
1923. *WOOD, J. G., B.Sc., Caius College, Cambridge, England.
1927. WOODLANDS, HAROLD, F.R.H.S., Adelaide.
1927. WOOLLARD, H. H., M.D., Professor of Anatomy, University of Adelaide.

APPENDIX.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

FORTY-FOURTH ANNUAL REPORT OF THE COMMITTEE

FOR THE YEAR ENDED AUGUST 31, 1927.

The Committee has pleasure in presenting the following report for the information of members.

MEMBERSHIP.—The number of members on the roll at the close of last year was 186, out of which 149 were financial. During the year under review 33 new members were enrolled; on the other hand, 40 have resigned, making a grand total of 179. Out of this total 138 are financial.

EXCURSIONS.—During the session 28 excursions have been held. The subjects dealt with have been Botany, Bird Life, Orchids, Cultivated Wild Flowers, Geology, Glacial Features, Autumn Tints, Shells and Fossils, Physiography, the Native Currant, Foothill Gums, Fungi, and general subjects. The best thanks of the Section are deserved by those who have led excursions and otherwise entertained the members.

LECTURES AND EXHIBITS.—We are much indebted to the following gentlemen who favoured the Section with lectures during the year on the subjects mentioned:—September 21, 1926, Mr. W. J. Kimber, "On the Cephalopods (Mollusca)"; October 19, Dr. H. Basedow, "Primitive Australia," illustrated by lantern slides; November 19, Mr. H. M. Hale, a lantern lecture on "Defensive Devices of Marine Animals"; March 15, 1927, Miss E. D. Macklin, B.Sc., "Seaweeds"; April 19, Dr. C. Fenner, Mr. W. Ham, F.R.E.S., and Mr. E. H. Ising lectured on a "Trip to Western Victoria." Three lantern lectures followed on trips undertaken, viz., May 17, Mr. H. M. Hale, "A Naturalist in North Queensland"; June 21, Mr. G. F. Hussey, "Across two Continents—Europe and America," and Mr. Edgar R. Waite, F.L.S., "A Naturalist Abroad"; August 16, "West Australian Evening," by Messrs. J. F. Bailey, A. M. Lea, F.E.S., H. M. Hale, Dr. C. Fenner, and Mr. E. H. Ising.

Lecturers have usually shown a good series of exhibits which have proved interesting and educational. The Committee invites more members to take part in this important part of the activities of the Section.

"THE SOUTH AUSTRALIAN NATURALIST."—Our Journal has been published each quarter, and under the capable guidance of Mr. W. Ham, the Editor, some interesting articles have been published. Anthropology has been represented by articles from Messrs. N. B. Tindale, H. M. Hale, and J. W. Hosking; Entomology, by Mr. F. G. Holdaway, B.Sc.; Conchology, by Mr. F. Trigg, Hon. Sec. Shell Collectors' Club; Botany, by Messrs. J. M. Black, L. Reese, J. F. Bailey, Prof. J. B. Cleland, and Mr. E. H. Ising; and general topics by Mr. W. Ham. The cost of printing Nos. 1 to 3 of Volume 8 is approximately £50. The part No. 4, to be issued shortly, will complete Volume 8.

Exchanges.—Local, Interstate, and Foreign exchanges are still maintained, and it is hoped that members may make full use of the publications received.

Flower Show, 1926.—The Seventh Annual Flower Show, held on October 15 and 16, in the Adelaide Town Hall, was very successful excepting financially. Only £25 4s. 1d. was cleared this year as compared with £43 6s. 4d. last year, *i.e.*, 1925. There is no doubt about the educational value of the exhibition, and it is hoped that efforts will be redoubled this year to make it known as widely as possible and to make it still more attractive.

Herbarium.—The work of the Herbarium is well maintained through the indefatigable efforts of Prof. J. B. Cleland and several members. There is still plenty of work to do in sorting and identifying specimens, and the Committee will welcome volunteers. Several collections have been received during the year, amongst others from Mr. and Mrs. C. Pearce, Thevenard; Mr. L. J. Kesting (head teacher), Mavis Elefson, Lionel Mudge, Alex. Lovegrove, Wirrulla School, Eyre's Peninsula; and Mr. F. D. Warren, Finniss Springs, *via* Marree. A fine lot of flowers was pressed from the various Schools' Exhibits sent down to the Show.

Australasian Association for the Advancement of Science, Hobart, January, 1928.—Receiving an invitation to send delegates to this meeting, Dr. C. Fenner and Mr. E. H. Ising were appointed.

W. Champion Hackett, *Chairman.*

Ernest H. Ising, *Hon. Sec.*

THIRTY-NINTH REPORT OF THE FLORA AND FAUNA PROTECTION COMMITTEE.

for the Year ended August 31, 1927.

The chief business for the year concerned the protection of the Native Currant. Letters were received from Mr. Fred. C. Richards, Assistant Secretary Central Agricultural Bureau, mentioning that a resolution was carried at the Conference of Lower North Branches of the Agricultural Bureau which read as follows:—"That the Government be requested to take steps to ensure the protection of the Native Currant *(Acrotriche depressa)* on Crown lands by the addition of a suitable clause in the agreement."

Letters were also received from residents of Williamstown District regretting the wholesale destruction of the Native Currant trees by persons visiting the district; also from Mr. F. Coleman, Saddleworth, and Mr. Edwin Ashby.

At a meeting held on March 22, 1927, the matter was deferred until the next meeting, which was held on June 30, 1927. At this meeting Mr. E. H. Ising resigned his office (as Secretary *pro. tem.)*, and Mr. Machell was appointed Secretary. The question of the protection of the Native Currant was further discussed, and the Secretary instructed to see what could be done in the matter.

Captain S. A. White was granted leave of absence during his trip abroad. Mr. W. Champion Hackett was appointed Acting Chairman.

A letter of thanks was sent to the Minister of Agriculture for action taken in curtailing the open season for opossums. An appropriate reply was received.

At a meeting held on July 21, 1927, a report was presented by the Secretary *re* protection of Native Currants. It was found that no Act was in force to

ensure protection. Notices against destruction of plants in parks and reserves were posted, from time to time, and similar notices had at one time or another appeared on certain Crown lands having reference to the destruction of Native Currants, etc.

The Secretary for Lands intimated that if a request for such notices to be posted were sent from this Committee it would receive consideration.

The Secretary of the Williamstown Agricultural Bureau was written to with regard to the notices, but reply was received that their effectiveness was doubted. However, the Secretary for Lands had been communicated with on the matter, and the Secretary of the Flora and Fauna Committee is proceeding to push the work further.

It is to be hoped that members will take a keen interest in the work of the coming year and lend all support possible.

W. Champion Hackett, *Act. Chairman.*

(Sgd.) J. E. Lewis Machell,

Hon. Sec. F. and F. Protection Committee.

ANNUAL REPORT OF THE SHELL COLLECTORS' COMMITTEE.

This Club held 20 Evening Meetings during the year just closed, the average attendance being 13 out of a total of 18 members.

Much useful work was accomplished during this period, members having applied themselves to the study of South Australian Mollusca in a most encouraging manner.

At each meeting definite families of shells were under survey, specimens of which were exhibited and viewed microscopically when necessary. Most of the known facts concerning them were mentioned, different authorities consulted, and many new thoughts and theories were expressed relative to them by members.

A preliminary review of all known South Australian Bivalves and Univalves has now been completed, comprising over 1,000 varieties. It is the intention of this Club to immediately begin a closer and more specialized study of these forms.

All members are now in possession of a complete Catalogue of South Australian Mollusca revised up to date. For this we have to express thanks to Sir Joseph Verco. These lists have been typed at the expense of Club members. Thanks are also due to the Royal Society for providing better lighting on the table, which became very necessary, especially when dealing with small material. Most members have assiduously collected specimens during the year, catalogued and mounted them for reference, and should now be possessed of a fair elementary knowledge of this interesting and fascinating branch of scientific study.

(Sgd.) W. J. Kimber, *Chairman.*

F. Trigg, *Hon. Sec.*

Adelaide, August 30, 1927.

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

Statement of Receipts and Expenditure for Year ended August 31, 1927.

GENERAL ACCOUNT.

Receipts.

1926-7—Sept. 1.	£ s. d.	£ s. d.
To Balance brought forward		30 0 7
,, Subscriptions		48 11 3
,, Other Receipts—		
Grant from Royal Society	50 0 0	
Flower Show	25 4 1	
Bank Interest	1 6 3	
Miscellaneous	0 11 6	
		77 1 10
		£155 13 8

To Balance brought forward Sept. 1, 1927, £19 13s. 7d.

Expenditure.

1926-7.	£ s. d.	£ s. d.
By Printing	61 7 10	
,, Advertising	3 6 0	
,, Postages, etc.	8 9 8	
,, Hire of Hall and Lantern	5 18 6	
,, Travelling Expenses	0 13 1	
,, Stationery, Books, etc.	5 12 2	
,, Miscellaneous	2 1 7	
,, Repayment to Royal Society	48 11 3	
		136 0 1
,, Bank Balance		19 13 7
		£155 13 8

Audited and found correct,

F. TRIGG, Hon. Treasurer.

WALTER D. REED, F.C.P.A., }
ALEX. J. MORISON, } Hon. Auditors.

August 31, 1927.

GENERAL INDEX.

[Generic and specific names in italics indicate that the forms described are new to science.]

CONTENTS.